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Marathon Oil

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Office of Enforcement, Compliance and Environmental Justice

November 1, 2018

Via Certified Mail: 7015 0640 0006 6407 1036

U. S. Environmental Protection Agency
Director, Air and Toxics Technical Enforcement Program
Office of Enforcement, Compliance, and Environmental Justice
Mail Code 8ENF-AT
1595 Wynkoop Street
Denver, Colorado 80202-1129

Dear Administrator:

In accordance with the requirements of Title 40 Code of Federal Regulations (CFR) Subpart OOOOa, Standards of Performance for Crude Oil and Natural Gas Facilities for which construction, modification, or reconstruction commenced after September 18, 2015, Marathon Oil Company (Marathon) hereby submits its annual report for the August 2, 2017 through August 1, 2018 reporting period as required by 40 CFR 49.4168(b). The report information is listed by regulatory citation as noted below:

40 CFR 5420a(b)(1)(i) The company name, facility site name associated with the affected facility, US Well ID or US Well ID associated with the affected facility, if applicable, and address of the affected facility. If an address is not available for the site, include a description of the site location and provide the latitude and longitude coordinates of the site in decimal degrees to an accuracy and precision of five (5) decimals of a degree using the North American Datum of 1983.

The company name is Marathon Oil Company, and the facility site name, well API number, and coordinates of each site are included in **Appendix A**.

40 CFR 5420a(b)(1)(ii) An identification of each affected facility being included in the annual report.

Appendix B contains a list of affected facilities by facility site name.

40 CFR 5420a(b)(1)(iii) Beginning and ending dates of the reporting period.

The reporting period is August 2, 2017 through August 1, 2018.

<u>40 CFR 5420a(b)(1)(iv)</u> A certification by a certifying official of truth, accuracy, and completeness. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

I certify based on information and belief formed after reasonable inquiry, that the statements and information in this document are true, accurate, and complete.

<u>40 CFR 5420a(b)(2)(i)</u> For each well affected facility, records of each well completion operation as specified in paragraphs (c)(1)(i) through (iv) and (vi) of §60.5420a, if applicable, for each well affected facility conducted during the reporting period. In lieu of submitting the records specified in paragraph (c)(1)(i) through (iv) of §60.5420a, the owner or operator may submit a list of the well completions with hydraulic fracturing completed during the reporting period and the records required by paragraph (c)(1)(v) of §60.5420a for each well completion.

1) **Records identifying each well completion operation for each well affected facility;**
   a) **Records of deviations in cases where well completion operations with hydraulic fracturing were not performed in compliance with the requirements specified in §60.5375a.**
   b) **Records required in §60.5375a(b) or (f)(3) for each well completion operation conducted for each well affected facility that occurred during the reporting period. You must maintain the records specified in paragraphs (c)(1)(iii)(A) through (C) of this section.**
      i) **(A) For each well affected facility required to comply with the requirements of §60.5375a(a), you must record: The location of the well; the United States Well Number; the date and time of the onset of flowback following hydraulic fracturing or re-fracturing; the date and time of each attempt to direct flowback to a separator as required in §60.5375a(a)(1)(ii); the date and time of each occurrence of returning to the initial flowback stage under §60.5375a(a)(1)(i); and the date and time that the well was shut in and the flowback equipment was permanently disconnected, or the startup of production; the duration of flowback; duration of recovery and disposition of recovery (*i.e.,* routed to the gas flow line or collection system, re-injected into the well or another well, used as an onsite fuel source, or used for another useful purpose that a purchased fuel or raw material would serve); duration of combustion; duration of venting; and specific reasons for venting in lieu of capture or combustion. The duration must be specified in hours. In addition, for wells where it is technically infeasible to route the recovered gas to any of the four options specified in §60.5375a(a)(1)(ii), you must record the reasons for the claim of technical infeasibility with respect to all four options provided in that subparagraph, including but not limited to; name and location of the nearest gathering line and technical considerations preventing routing to this line; capture, reinjection, and reuse technologies considered and aspects of gas or equipment preventing use of recovered gas as a fuel onsite; and technical considerations preventing use of recovered gas for other useful purpose that that a purchased fuel or raw material would serve.**

c) **For each well affected facility required to comply with the requirements of §60.5375a(f), you must maintain the records specified in paragraph (c)(1)(iii)(A) of §60.5420a except that you do not have to record the duration of recovery to the flow line.**
d) **For each well affected facility for which you make a claim that it meets the criteria of §60.5375a(a)(1)(iii)(A), you must maintain the following:**
   i) **Records specified in paragraph (c)(1)(iii)(A) of this section except that you do not have to record: The date and time of each attempt to direct flowback to a separator; the date and time of each occurrence of returning to the initial flowback stage; duration of recovery and disposition of recovery (*i.e.* routed to the gas flow line or collection system, re-injected into the well or another well, used as an onsite fuel source, or used for another useful purpose that a purchased fuel or raw material would serve.**
   ii) **If applicable, records that the conditions of §60.5375a(1)(iii)(A) are no longer met and that the well completion operation has been stopped and a separator installed. The records shall include the date and time the well completion operation was stopped and the date and time the separator was installed.**
   iii) **A record of the claim signed by the certifying official that no liquids collection is at the well site. The claim must include a certification by a certifying official of truth, accuracy and completeness. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.**
   iv) **For each well affected facility for which you claim an exception under §60.5375a(a)(3), you must record: The location of the well; the United States Well Number; the specific exception claimed; the starting date and ending date for the period the well operated under the exception; and an explanation of why the well meets the claimed exception.**

Well completions with hydraulic fracturing which occurred during the reporting period are included in **Appendix C**. Marathon does not claim any exceptions under §60.5375a(a)(3).

<u>40 CFR 5420a(b)(2)(ii)</u> For each well affected facility, records of deviations specified in paragraph (c)(1)(ii) of §60.5420a that occurred during the reporting period.

There were no deviations associated with well completion operations which occurred during the reporting period.

<u>40 CFR 5420a(b)(2)(iii)</u> For each well affected facility, records specified in paragraph (c)(1)(vii) of §60.5420a, if applicable, that support a determination under 60.5432a that the well affected facility is a low pressure well as defined in 60.5430a.

There were no low pressure well completion operations which occurred during the reporting period.

<u>40 CFR 5420a(b)(3)(i)</u> For each centrifugal compressor affected facility, an identification of each centrifugal compressor using a wet seal system constructed, modified or reconstructed during the reporting period.

There were no centrifugal compressor affected facilities using a wet seal system constructed, modified, or reconstructed by Marathon during the reporting period.

<u>40 CFR 5420a(b)(3)(ii)</u> For each centrifugal compressor affected facility, records of deviations specified in paragraph (c)(2) of §60.5420a that occurred during the reporting period.

There were no deviations associated with centrifugal compressor affected facilities during the reporting period.

<u>40 CFR 5420a(b)(3)(iii)</u> For each centrifugal compressor affected facility, if required to comply with §60.5380a(a)(2), the records specified in paragraphs (c)(6) through (11) of §60.5420a.

Marathon did not operate, construct, modify, or reconstruct any centrifugal compressor affected facility during the reporting period. Therefore there are no records as specified in paragraphs (c) (6) through (11) of §60.5420a.

<u>40 CFR 5420a(b)(3)(iv)</u> If complying with §60.5380a(a)(1) with a control device tested under §60.5413a(d) which meets the criteria in §60.5413a(d)(11) and §60.5413a(e), records specified in paragraph (c)(2)(i) through (c)(2)(vii) of §60.5420a for each centrifugal compressor using a wet seal system constructed, modified or reconstructed during the reporting period.

Marathon did not operate any centrifugal compressors with wet seal systems during the reporting period.

<u>40 CFR 5420a(b)(4)(i)</u> For each reciprocating compressor affected facility, the cumulative number of hours of operation or the number of months since initial startup or since the previous reciprocating compressor rod packing replacement, whichever is later. Alternatively, a statement that emissions from the rod packing are being routed to a process through a closed vent system under negative pressure.

Marathon did not operate construct, modify, or reconstruct any reciprocating compressor affected facilities during the reporting period.

<u>40 CFR 5420a(b)(4)(ii)</u> For each reciprocating compressor affected facility, records of deviations specified in paragraph (c)(3)(iii) of §60.5420a that occurred during the reporting period.

Marathon did not construct, modify, or reconstruct any reciprocating compressor affected facilities during the reporting period.

40 CFR 5420a(b)(5)(i) **For each pneumatic controller affected facility, an identification of each pneumatic controller constructed, modified or reconstructed during the reporting period, including the identification information specified in §60.5390a(b)(2) or (c)(2).**

Marathon did not construct, modify, or reconstruct any pneumatic controller affected facilities during the reporting period

40 CFR 5420a(b)(5)(ii) **For each pneumatic controller affected facility, if applicable, documentation that the use of pneumatic controller affected facilities with a natural gas bleed rate greater than 6 standard cubic feet per hour are required and the reasons why.**

Marathon did not construct, modify, or reconstruct any pneumatic controller affected facilities during the reporting period.

40 CFR 5420a(b)(5)(iii) **For each pneumatic controller affected facility, records of deviations specified in paragraph (c)(4)(v) of §60.5420a that occurred during the reporting period.**

Marathon did not construct, modify, or reconstruct any pneumatic controller affected facilities during the reporting period.

40 CFR 5420a(b)(6)(i) **For each storage vessel affected facility, an identification, including the location, of each storage vessel affected facility for which construction, modification or reconstruction commenced during the reporting period. The location of the storage vessel shall be in latitude and longitude coordinates in decimal degrees to an accuracy and precision of five (5) decimals of a degree using the North American Datum of 1983.**

Appendix D contains a list of storage vessel affected facilities.

40 CFR 5420a(b)(6)(ii) **For each storage vessel affected facility, documentation of the VOC emission rate determination according to §60.5365a(e) for each storage vessel that became an affected facility during the reporting period or is returned to service during the reporting period.**

Storage vessel affected facility VOC emission rate determinations are included in **Appendix E**.

40 CFR 5420a(b)(6)(iii) **For each storage vessel affected facility, records of deviations specified in paragraph (c)(5)(iii) of §60.5420a that occurred during the reporting period.**

Deviations associated with storage tank requirements are identified in **Appendix F** by facility site name.

40 CFR 5420a(b)(6)(iv) For each storage vessel affected facility, a statement that you have met the requirements specified in §60.5410a(h)(2) and (3).

VOC emission rates were reduced in accordance with the requirements of §60.5365a(e)(1) through (e)(4) including the cover requirements specified in §60.5411a(b) and the closed vent system requirements specified in §60.5411a(c). A control device was used to reduce emissions, and initial compliance was determined by meeting the requirements in §60.5395a(e), including the control device requirements in §60.5412a(d)(3). The control device requirements in §60.5412a(c) did not apply since Marathon does not operate any carbon absorption systems.

40 CFR 5420a(b)(6)(v) For each storage vessel affected facility, you must identify each storage vessel affected facility that is removed from service during the reporting period as specified in §60.5395a(c)(1)(ii), including the date the storage vessel affected facility was removed from service.

No storage vessel affected facilities were removed from service during the reporting period.

40 CFR 5420a(b)(6)(vi) You must identify each storage vessel affected facility returned to service during the reporting period as specified in §60.5395a(c)(3), including the date the storage vessel affected facility was returned to service.

No storage vessel affected facility was returned to service during the reporting period.

40 CFR 5420a(b)(6)(vii) For each storage vessel affected facility, if complying with §60.5395a(a)(2) with a control device tested under §60.5413a(d) which meets the criteria in §60.5413a(d)(11) and §60.5413a(e), records specified in paragraphs (c)(5)(vi)(A) through (F) of §60.5420a for each storage vessel constructed, modified, reconstructed or returned to service during the reporting period.

Marathon did not operate any combustion control devices with a manufacturer's performance test during the reporting period.

40 CFR 5420a(b)(7) For the collection of fugitive emissions components at each well site and the collection of fugitive emissions components at each compressor station within the company-defined area, the records of each monitoring survey including the information specified in paragraphs (b)(7)(i) through (xii) of §60.5420a . For the collection of fugitive emissions components at a compressor station, if a monitoring survey is waived under §60.5397a(g)(5), you must include in your annual report the fact that a monitoring survey was waived and the calendar months that make up the quarterly monitoring period for which the monitoring survey was waived.

1) **Date of the survey.**
2) **Beginning and end time of the survey.**
3) **Name of operator(s) performing survey. If the survey is performed by optical gas imaging, you must note the training and experience of the operator.**
4) **Ambient temperature, sky conditions, and maximum wind speed at the time of the survey.**
5) **Monitoring instrument used.**

6) **Any deviations from the monitoring plan or a statement that there were no deviations from the monitoring plan.**
7) **Number and type of components for which fugitive emissions were detected.**
8) **Number and type of fugitive emissions components that were not repaired as required in §60.5397a(h).**
9) **Number and type of difficult-to-monitor and unsafe-to-monitor fugitive emission components monitored.**
10) **The date of successful repair of the fugitive emissions component.**
11) **Number and type of fugitive emission components placed on delay of repair and explanation for each delay of repair.**
12) **Type of instrument used to resurvey a repaired fugitive emissions component that could not be repaired during the initial fugitive emissions finding.**

The required records are located in **Appendix G**.

<u>40 CFR 5420a(b)(8)(i)</u> For each pneumatic pump that is constructed, modified or reconstructed during the reporting period, you must provide certification that the pneumatic pump meets one of the conditions described in paragraphs (b)(8)(i)(A), (B) or (C) of this section.

1) **No control device or process is available on site.**
2) **A control device or process is available on site and the owner or operator has determined in accordance with §60.5393a(b)(5) that it is technically infeasible to capture and route the emissions to the control device or process.**
3) **Emissions from the pneumatic pump are routed to a control device or process. If the control device is designed to achieve less than 95 percent emissions reduction, specify the percent emissions reductions the control device is designed to achieve.**

No pneumatic pumps were constructed, modified, or reconstructed at the facilities listed in **Appendix A** during the reporting period.

<u>40 CFR 5420a(b)(8)(ii)</u> For any pneumatic pump affected facility which has been previously reported as required under paragraph (b)(8)(i) of §60.5420a and for which a change in the reported condition has occurred during the reporting period, provide the identification of the pneumatic pump affected facility and the date it was previously reported and a certification that the pneumatic pump meets one of the conditions described in paragraphs (b)(8)(ii)(A), (B) or (C) or (D) of this section.

1) **A control device has been added to the location and the pneumatic pump now reports according to paragraph (b)(8)(i)(C) of this section.**
2) **A control device has been added to the location and the pneumatic pump affected facility now reports according to paragraph (b)(8)(i)(B) of this section.**
3) **A control device or process has been removed from the location or otherwise is no longer available and the pneumatic pump affected facility now report according to paragraph (b)(8)(i)(A) of this section.**
4) **A control device or process has been removed from the location or is otherwise no longer available and the owner or operator has determined in accordance with §60.5393a(b)(5)**

through an engineering evaluation that it is technically infeasible to capture and route the emissions to another control device or process.

No pneumatic pumps were constructed, modified, or reconstructed at the facilities listed in **Appendix A** during the reporting period.

40 CFR 5420a(b)(8)(iii) For any pneumatic pump affected facility, records of deviations specified in paragraph (c)(16)(ii) of §5420a that occurred during the reporting period.

No pneumatic pumps were constructed during the reporting period.

40 CFR 5420a(b)(9) Within 60 days after the date of completing each performance test (see §60.8) required by 40 CFR 60.5420a, except testing conducted by the manufacturer as specified in §60.5413a(d), you must submit the results of the performance test following the procedure specified in either paragraph (b)(9)(i) or (ii) of §60.5420a.

1) **For data collected using test methods supported by the EPA's Electronic Reporting Tool (ERT) as listed on the EPA's ERT Web site (*https://www3.epa.gov/ttn/chief/ert/ert_info.html*) at the time of the test, you must submit the results of the performance test to the EPA via the Compliance and Emissions Data Reporting Interface (CEDRI). (CEDRI can be accessed through the EPA's Central Data Exchange (CDX) (*https://cdx.epa.gov/*).) Performance test data must be submitted in a file format generated through the use of the EPA's ERT or an alternate electronic file format consistent with the extensible markup language (XML) schema listed on the EPA's ERT Web site. If you claim that some of the performance test information being submitted is confidential business information (CBI), you must submit a complete file generated through the use of the EPA's ERT or an alternate electronic file consistent with the XML schema listed on the EPA's ERT Web site, including information claimed to be CBI, on a compact disc, flash drive, or other commonly used electronic storage media to the EPA. The electronic media must be clearly marked as CBI and mailed to U.S. EPA/OAQPS/CORE CBI Office, Attention: Group Leader, Measurement Policy Group, MD C404-02, 4930 Old Page Rd., Durham, NC 27703. The same ERT or alternate file with the CBI omitted must be submitted to the EPA via the EPA's CDX as described earlier in this paragraph.**
2) **For data collected using test methods that are not supported by the EPA's ERT as listed on the EPA's ERT Web site at the time of the test, you must submit the results of the performance test to the Administrator at the appropriate address listed in §60.4.**

No performance tests were conducted by Marathon during the reporting period.

40 CFR 5420a(b)(10) For combustion control devices tested by the manufacturer in accordance with §60.5413a(d), an electronic copy of the performance test results required by §60.5413a(d) shall be submitted via email to *Oil_and_Gas_PT@EPA.GOV* unless the test results for that model of combustion control device are posted at the following Web site: *epa.gov/airquality/oilandgas/*.

No combustion control devices were installed by Marathon during the reporting period.

<u>40 CFR 5420a(b)(11)</u> You must submit reports to the EPA via the CEDRI. (CEDRI can be accessed through the EPA's CDX (*https://cdx.epa.gov/*).) You must use the appropriate electronic report in CEDRI for this subpart or an alternate electronic file format consistent with the extensible markup language (XML) schema listed on the CEDRI Web site (*https://www3.epa.gov/ttn/chief/cedri/*). If the reporting form specific to this subpart is not available in CEDRI at the time that the report is due, you must submit the report to the Administrator at the appropriate address listed in §60.4. Once the form has been available in CEDRI for at least 90 calendar days, you must begin submitting all subsequent reports via CEDRI. The reports must be submitted by the deadlines specified in this subpart, regardless of the method in which the reports are submitted.

No reports were submitted to the EPA via the CEDRI by Marathon during the reporting period.

<u>40 CFR 5420a(b)(12)</u> You must submit the certification signed by the qualified professional engineer according to §60.5411a(d) for each closed vent system routing to a control device or process.

The certifications signed by a qualified professional engineer according to §60.5411a(d) were included in Appendix H for the wells included in Appendix A which were designed and constructed during the reporting period.

Please do not hesitate to contact me if you require additional information concerning this report.

Sincerely,

(b) (6) [redacted]

Jeff Parker

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Bingo 24-10TFH	33-061-03580	(b) (9) [redacted]	(b) (9) [redacted]
Marjorie 14-10H	33-061-03579	[redacted]	[redacted]
JL Shobe 24-10TFH	33-061-03581	[redacted]	[redacted]
Charlie 24-10H	33-061-03582	[redacted]	[redacted]
Mikkelsen 11-14H	33-061-03585	[redacted]	[redacted]
Ringer 14-21TFH	33-025-02659	[redacted]	[redacted]
Trinity 14-21H	33-025-02658	[redacted]	[redacted]
Wilhelm 24-21TFH	33-025-02660	[redacted]	[redacted]
Ulmer 24-21H	33-025-02661	[redacted]	[redacted]
Martinez USA 24-8H	33-025-03025	[redacted]	[redacted]
Crosby USA 41-6H	33-025-03005	[redacted]	[redacted]
Eagle USA 41-5H	33-025-01867	[redacted]	[redacted]
Clarks Creek USA 14-35H	33-053-06865	[redacted]	[redacted]
Charmaine USA 14-35TFH	33-053-06864	[redacted]	[redacted]
Heather USA 13-35TFH	33-053-06867	[redacted]	[redacted]
Juanita USA 13-35H	33-053-06868	[redacted]	[redacted]
Raymond USA 41-4H	33-061-01068	[redacted]	[redacted]
Maggie USA 21-4H	33-061-03527	[redacted]	[redacted]
Hannah USA 31-4TFH	33-061-03528	[redacted]	[redacted]
Rufus USA 21-4TFH	33-061-03526	[redacted]	[redacted]
Goldberg USA 24-33TFH	33-061-03523	[redacted]	[redacted]

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Anton 34-33TFH	33-061-03525	(b) (9) [redacted]	(b) (9) [redacted]
Gaynor 34-33H	33-061-03524		
Ronald 34-33TFH-2B	33-061-03804		
Ladonna Klatt 24-22H	33-025-00733		
Mattie 14-22TFH	33-025-02515		
Hollingsworth 24-22TFH	33-025-02516		
Darvey Klatt 44-22H	33-025-00921		
Arden USA 14-9TFH	33-053-07508		
Iron Woman USA 14-9H	33-053-07921		
Reno USA 24-9TFH-2B	33-053-07506		
Garness USA 31-4TFH-2B	33-053-07474		
Marcella USA 21-4TFH	33-053-07473		
Cunningham USA 31-4H	33-053-07475		
Lacey USA 11-5H	33-061-03754		
Trotter 14-23H	33-025-00684		
Pelton 24-31H	33-025-00760		
Darcy 34-32H	33-025-00642		
Larry Repp 31-6H	33-025-00720		
Oneil 24-24H	33-025-00770		
Oneil 34-24H	33-025-00830		
Marlin 24-12H	33-025-00579		
Hondo 34-12TFH	33-025-03257		
Quill 34-11H	33-025-00810		
Repp 34-34H	33-025-00655		
Oscar Stohler 41-4H	33-025-00610		

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Mittelstadt 34-12H	33-025-03256	(b) (9) [redacted]	(b) (9) [redacted]
Fred Hansen 34-8H	33-025-00749		
Mary Hansen 14-9H	33-025-00693		
Moline 14-32H	33-061-03755		
Kermit USA 14-9H	33-053-07507		
Grady USA 21-4H	33-053-07472		
Homme 11-18TFH	33-061-04007		
Charchenko 14-21H	33-025-00797		
Beck 14-8H	33-025-00649		
Kukla 34-34H	33-025-00606		
Double H 34-8TFH	33-025-02691		
Stark 44-35TFH	33-061-03725		
Tescher 11-27H	33-025-01071		
Clarice USA 14-9H	33-025-02687		
Shrader 41-13H	33-061-04004		
Brush 24-8H	33-025-02832		
Harley 14-36TFH	33-061-04002		
WM & Agnes Scott 14-25H	33-025-00818		
Torrison 24-8TFH	33-025-02831		
Lund 44-35H	33-061-04001		
Appledoorn 14-19H	33-025-00692		
Christensen 34-33H	33-025-00699		
Beck 24-8H	33-025-00636		
Houser 14-36H	33-061-04003		
French 31-15TFH	33-025-03262		

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Voigt 11-15H	33-025-00700	(b) (9) [redacted]	(b) (9) [redacted]
Kemp Trust 21-14H	33-025-00870		
Chapman 31-15H	33-025-03263		
Spring 21-15TFH	33-025-03264		
Forsman USA 44-22H	33-053-07703		
Lockwood USA 44-22TFH	33-053-07704		
Lena USA 14-22H	33-053-07922		
Murphy 34-22TFH-2B	33-053-07705		
Veronica 14-22TFH	33-053-06520		
Begola USA 34-22H	33-053-07706		
Tat USA 14-22H	33-053-06658		
Tat USA 34-22H	33-053-03182		
Rough Coulee USA 24-22TFH	33-053-06521		
Deane USA 24-22H	33-053-06522		
Arkin 44-12TFH	33-025-03294		
BLUE CREEK 24-22TFH-2B	33-053-06518		
Bronett 14-7H	33-025-03293		
Ernst 14-7TFH	33-025-03267		
Kenneth 24-7TFH	33-025-03268		
Stroup 34-7TFH	33-025-03270		
Bethol 34-7H	33-025-03269		
Chauncey USA 31-2H	33-053-07956		
June USA 31-2H	33-053-07958		
Hunts Along USA 12-1H	33-053-03083		
Wilbur USA 31-2TFH	33-053-07957		

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Mark USA 11-1H	33-053-07990	(b) (9) [redacted]	(b) (9) [redacted]
Winona USA 21-2TFH-2B	33-053-07955	[redacted]	[redacted]
Shoots USA 41-2H	33-053-07988	[redacted]	[redacted]
Miles 41-2TFH-2B	33-053-07959	[redacted]	[redacted]
Mamie USA 21-11TFH	33-053-07989	[redacted]	[redacted]
Demaray USA 41-2TFH	33-053-07693	[redacted]	[redacted]
Bear Den 42-5TFH	33-025-01773	[redacted]	[redacted]
Timothy USA 11-1TFH-2B	33-053-07991	[redacted]	[redacted]
Struthers USA 41-5H	33-025-03124	[redacted]	[redacted]
Ross 42-5H	33-025-01774	[redacted]	[redacted]
Ryan 42-5TFH	33-025-03123	[redacted]	[redacted]
Hillesland 31-3TFH	33-025-02792	[redacted]	[redacted]
Rita 41-3TFH	33-025-03310	[redacted]	[redacted]
Stanton 41-3H	33-025-03309	[redacted]	[redacted]
Olea 24-11TFH	33-025-03305	[redacted]	[redacted]
Sundby 24-11TFH	33-025-03307	[redacted]	[redacted]
Marlene 34-11TFH	33-025-03282	[redacted]	[redacted]
Hugo 34-11H	33-025-03279	[redacted]	[redacted]
Chimney Butte 34-11H	33-025-00804	[redacted]	[redacted]
Gravel Coulee 14-11TFH	33-025-03311	[redacted]	[redacted]
McFadden 14-11H	33-025-03304	[redacted]	[redacted]
Morrison 24-11H	33-025-03306	[redacted]	[redacted]
Gifford 34-11TFH	33-025-03280	[redacted]	[redacted]
Tipton 34-11H	33-025-03281	[redacted]	[redacted]
Kattevold USA 14-34TFH	33-061-04052	[redacted]	[redacted]

Appendix A -- List of Affected Facilities Sites

Well/Facility Name	API Number	Latitude	Longitude
Alexander USA 44-33TFH	33-061-04050	(b) (9) [redacted]	(b) (9) [redacted]
Pfundheller USA 44-33H	33-061-04051	[redacted]	[redacted]
Colvin USA 14-34TFH	33-061-03831	[redacted]	[redacted]
Ranger USA 24-34TFH	33-061-03833	[redacted]	[redacted]
Lois USA 14-34H	33-061-04055	[redacted]	[redacted]

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Bingo 24-10TFH	Yes	No	No	No	No	Yes	Yes
Marjorie 14-10H	Yes	No	No	No	No	Yes	Yes
JL Shobe 24-10TFH	Yes	No	No	No	No	Yes	Yes
Charlie 24-10H	Yes	No	No	No	No	Yes	Yes
Mikkelsen 11-14H	Yes	No	No	No	No	Yes	Yes
Ringer 14-21TFH	Yes	No	No	No	No	Yes	Yes
Trinity 14-21H	Yes	No	No	No	No	Yes	Yes
Wilhelm 24-21TFH	Yes	No	No	No	No	Yes	Yes
Ulmer 24-21H	Yes	No	No	No	No	Yes	Yes
Martinez USA 24-8H	Yes	No	No	No	No	Yes	Yes
Crosby USA 41-6H	Yes	No	No	No	No	Yes	Yes
Eagle USA 41-5H	Yes	No	No	No	No	Yes	Yes
Clarks Creek USA 14-35H	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Charmaine USA 14-35TFH	Yes	No	No	No	No	Yes	Yes
Heather USA 13-35TFH	Yes	No	No	No	No	Yes	Yes
Juanita USA 13-35H	Yes	No	No	No	No	Yes	Yes
Raymond USA 41-4H	Yes	No	No	No	No	Yes	Yes
Maggie USA 21-4H	Yes	No	No	No	No	Yes	Yes
Hannah USA 31-4TFH	Yes	No	No	No	No	Yes	Yes
Rufus USA 21-4TFH	Yes	No	No	No	No	Yes	Yes
Goldberg USA 24-33TFH	Yes	No	No	No	No	Yes	Yes
Anton 34-33TFH	Yes	No	No	No	No	Yes	Yes
Gaynor 34-33H	Yes	No	No	No	No	Yes	Yes
Ronald 34-33TFH-2B	Yes	No	No	No	No	Yes	Yes
Ladonna Klatt 24-22H	Yes	No	No	No	No	Yes	Yes
Mattie 14-22TFH	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Hollingsworth 24-22TFH	Yes	No	No	No	No	Yes	Yes
Darvey Klatt 44-22H	Yes	No	No	No	No	Yes	Yes
Arden USA 14-9TFH	Yes	No	No	No	No	Yes	Yes
Iron Woman USA 14-9H	Yes	No	No	No	No	Yes	Yes
Reno USA 24-9TFH-2B	Yes	No	No	No	No	Yes	Yes
Garness USA 31-4TFH-2B	Yes	No	No	No	No	Yes	Yes
Marcella USA 21-4TFH	Yes	No	No	No	No	Yes	Yes
Cunningham USA 31-4H	Yes	No	No	No	No	Yes	Yes
Lacey USA 11-5H	Yes	No	No	No	No	Yes	Yes
Trotter 14-23H	Yes	No	No	No	No	Yes	Yes
Pelton 34-31H	Yes	No	No	No	No	Yes	Yes
Darcy 34-32H	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Larry Repp 31-6H	Yes	No	No	No	No	No	Yes
Oneil 24-24H	Yes	No	No	No	No	Yes	Yes
Oneil 34-24H	Yes	No	No	No	No	Yes	Yes
Marlin 24-12H	Yes	No	No	No	No	Yes	Yes
Hondo 34-12TFH	Yes	No	No	No	No	Yes	Yes
Quill 34-11H	Yes	No	No	No	No	No	Yes
Repp 34-34H	Yes	No	No	No	No	Yes	Yes
Oscar Stohler 41-4H	Yes	No	No	No	No	Yes	Yes
Mittelstadt 34-12H	Yes	No	No	No	No	Yes	Yes
Fred Hansen 34-8H	Yes	No	No	No	No	Yes	Yes
Repp Trust 34-9H	Yes	No	No	No	No	No	Yes
Mary Hansen 14-9H	Yes	No	No	No	No	No	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Moline 14-32H	Yes	No	No	No	No	Yes	Yes
Kermit USA 14-9H	Yes	No	No	No	No	Yes	Yes
Grady USA 21-4H	Yes	No	No	No	No	Yes	Yes
Homme 11-18TFH	Yes	No	No	No	No	No	Yes
Charchenko 14-21H	Yes	No	No	No	No	No	Yes
Beck 14-8H	Yes	No	No	No	No	Yes	Yes
Kukla 34-34H	Yes	No	No	No	No	Yes	Yes
Double H 34-8TFH	Yes	No	No	No	No	Yes	Yes
STARK 44-35TFH	Yes	No	No	No	No	Yes	Yes
Tescher 11-27H	Yes	No	No	No	No	Yes	Yes
Clarice USA 14-9H	Yes	No	No	No	No	Yes	Yes
Shrader 41-13H	Yes	No	No	No	No	No	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Brush 24-8H	Yes	No	No	No	No	Yes	Yes
HARLEY 14-36TFH	Yes	No	No	No	No	Yes	Yes
WM & Agnes Scott 14-25H	Yes	No	No	No	No	No	Yes
Torrison 24-8TFH	Yes	No	No	No	No	Yes	Yes
Lund 44-35H	Yes	No	No	No	No	Yes	Yes
Appledorn 14-19H	Yes	No	No	No	No	Yes	Yes
Christensen 34-33H	Yes	No	No	No	No	Yes	Yes
Beck 24-8H	Yes	No	No	No	No	Yes	Yes
Houser 14-36H	Yes	No	No	No	No	Yes	Yes
French 31-15TFH	Yes	No	No	No	No	Yes	Yes
Voigt 11-15H	Yes	No	No	No	No	Yes	Yes
Kempf Trust 21-14H	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Chapman 31-15H	Yes	No	No	No	No	Yes	Yes
Spring 21-15TFH	Yes	No	No	No	No	Yes	Yes
Forsman USA 44-22H	Yes	No	No	No	No	Yes	Yes
Lockwood USA 44-22TFH	Yes	No	No	No	No	Yes	Yes
Lena USA 14-22H	Yes	No	No	No	No	Yes	Yes
Murphy 34-22TFH-2B	Yes	No	No	No	No	Yes	Yes
Veronica 14-22TFH	Yes	No	No	No	No	Yes	Yes
Begola USA 34-22H	Yes	No	No	No	No	Yes	Yes
Tat USA 14-22H	Yes	No	No	No	No	Yes	Yes
Tat USA 34-22H	Yes	No	No	No	No	Yes	Yes
Rough Coulee USA 24-22TFH	Yes	No	No	No	No	Yes	Yes
Deane USA 24-22H	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Arkin 44-12TFH	Yes	No	No	No	No	Yes	Yes
BLUE CREEK 24-22TFH-2B	Yes	No	No	No	No	Yes	Yes
Bronett 14-7H	Yes	No	No	No	No	Yes	Yes
Ernst 14-7TFH	Yes	No	No	No	No	Yes	Yes
Kenneth 24-7TFH	Yes	No	No	No	No	Yes	Yes
Stroup 34-7TFH	Yes	No	No	No	No	Yes	Yes
Bethol 34-7H	Yes	No	No	No	No	Yes	Yes
Chauncey USA 31-2H	Yes	No	No	No	No	Yes	Yes
June USA 31-2H	Yes	No	No	No	No	Yes	Yes
Hunts Along USA 12-1H	Yes	No	No	No	No	Yes	Yes
Wilbur USA 31-2TFH	Yes	No	No	No	No	Yes	Yes
Mark USA 11-1H	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Winona USA 21-2TFH-2B	Yes	No	No	No	No	Yes	Yes
Shoots USA 41-2H	Yes	No	No	No	No	Yes	Yes
Miles 41-2TFH-2B	Yes	No	No	No	No	Yes	Yes
Mamie USA 21-11TFH	Yes	No	No	No	No	Yes	Yes
Demaray USA 41-2TFH	Yes	No	No	No	No	Yes	Yes
Bear Den 42-5TFH	Yes	No	No	No	No	Yes	Yes
Timothy USA 11-1TFH-2B	Yes	No	No	No	No	Yes	Yes
Struthers USA 41-5H	Yes	No	No	No	No	Yes	Yes
Ross 42-5H	Yes	No	No	No	No	Yes	Yes
Ryan 42-5TFH	Yes	No	No	No	No	Yes	Yes
Hillesland 31-3TFH	Yes	No	No	No	No	Yes	Yes
Rita 41-3TFH	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Stanton 41-3H	Yes	No	No	No	No	Yes	Yes
Olea 24-11TFH	Yes	No	No	No	No	Yes	Yes
Sundby 24-11TFH	Yes	No	No	No	No	Yes	Yes
Marlene 34-11TFH	Yes	No	No	No	No	Yes	Yes
Hugo 34-11H	Yes	No	No	No	No	Yes	Yes
Chimney Butte 34-11H	Yes	No	No	No	No	Yes	Yes
Gravel Coulee 14-11TFH	Yes	No	No	No	No	Yes	Yes
McFadden 14-11H	Yes	No	No	No	No	Yes	Yes
Morrison 24-11H	Yes	No	No	No	No	Yes	Yes
Gifford 34-11TFH	Yes	No	No	No	No	Yes	Yes
Tipton 34-11H	Yes	No	No	No	No	Yes	Yes
Kattevold USA 14-34TFH	Yes	No	No	No	No	Yes	Yes

Appendix B – Affected Facility Information

Well/Facility Name	Well	Centrifugal Compressor	Reciprocating Compressor	Pneumatic Controller	Pneumatic Pump	Storage Vessel	Fugitive Emissions Components
Alexander USA 44-33TFH	Yes	No	No	No	No	TBD	Yes
Pfundheller USA 44-33H	Yes	No	No	No	No	TBD	Yes
Colvin USA 14-34TFH	Yes	No	No	No	No	TBD	Yes
Ranger USA 24-34TFH	Yes	No	No	No	No	TBD	Yes
Lois USA 14-34H	Yes	No	No	No	No	TBD	Yes

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Moline 14-32H	33-061-03755	8/4/2017 16:00	8/4/2017 16:00	8/8/2017 05:00	110 hours	Combustion for 110 hours
Kermit USA 14-9H	33-053-07507	8/3/2017 03:00	8/3/2017 03:00	8/11/2017 05:00	201 hours	Combustion for 201 hours
Grady USA 21-4H	33-053-07472	8/10/2017 10:00	8/10/2017 10:00	8/19/2017 05:00	291 hours	Combustion for 215 hours
Homme 11-18TFH	33-061-04007	8/19/2017 14:30	8/19/2017 14:30	8/25/2017 05:00	158.5 hours	Gas Sales and Combustion for 158.5 hours
Charchenko 14-21H	33-025-00797	8/23/2017 16:00	8/23/2017 16:00	8/29/2017 05:00	159 hours	Gas Sales and Combustion for 159 hours
Beck 14-8H	33-025-00649	8/26/2017 14:00	8/26/2017 14:00	9/8/2017 05:00	326 hours	Combustion for 326 hours
Kukla 34-34H	33-025-00606	9/15/2017 07:00	9/15/2017 07:00	9/22/2017 05:00	185 hours	Combustion for 185 hours
Double H 34-8TFH	33-025-02691	9/9/2017 14:30	9/9/2017 14:30	9/28/2017 05:00	381 hours	Combustions for 381 hours
Stark 44-35TFH	33-061-03725	9/23/2017 05:00	9/23/2017 05:00	9/30/2017 12:00	157 hours	Combustion for 157 hours
Tescher 11-27H	33-025-01071	9/21/2017 06:45	9/21/2017 06:45	10/1/2017 05:00	221 hours	Gas Sales and Combustion for 221 hours
Clarice USA 14-9H	33-025-02687	9/7/2017 16:00	9/7/2017 16:00	10/1/2017 05:00	517.5 hours	Combustion for 517.5 hours
Shrader 41-13H	33-061-04004	8/28/2017 06:00	8/28/2017 06:00	9/30/2017 13:00	629 hours	Gas sales and Combustion for 629 hours

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Brush 24-8H	33-025-02832	9/1/2017 12:00	9/1/2017 12:00	10/2/2017 05:00	597 hours	Combustion for 597 hours
Harley 14-36TFH	33-061-04002	9/27/2017 11:30	9/27/2017 11:30	10/4/2017 05:00	186 hours	Combustion for 186 hours
WM & Agnes Scott 14-25H	33-025-00818	10/4/2017 6:00	10/4/2017 6:00	10/9/2017 10:00	119 hours	Combustion for 119 hours
Torrison 24-8TFH	33-025-02831	9/30/2017 11:40	9/30/2017 11:40	10/10/2017 05:00	255 hours	Combustion for 255 hours
Lund 44-35H	33-061-04001	9/30/2017 18:00	9/30/2017 18:00	10/11/2017 05:00	266 hours	Combustion for 266 hours
Appledorn 14-19H	33-025-00692	10/8/2017 15:00	10/8/2017 15:00	10/16/2017 05:00	201 hours	Combustion for 201 hours
Christensen 34-33H	33-025-00699	10/6/2017 10:00	10/6/2017 10:00	10/17/2017 05:00	278 hours	Combustion for 278 hours
Beck 24-8H	33-025-00636	10/4/2017 08:00	10/4/2017 08:00	10/18/2017 05:00	352 hours	Combustion for 352 hours
Houser 14-36H	33-061-04003	10/4/2017 04:00	10/4/2017 04:00	10/27/2017 07:00	537 hours	Combustion for 537 hours
French 31-15TFH	33-025-03262	10/18/2017 08:30	10/18/2017 08:30	10/27/2017	237 hours	Combustion for 237 hours
Voigt 11-15H	33-025-00700	10/11/2017 04:00	10/11/2017 04:00	10/30/2017 05:00	476 hours	Combustion for 476 hours
Kemp Trust 21-14H	33-025-00870	10/25/2017 14:00	10/25/2017 14:00	11/5/2017 05:00	281 hours	Combustion for 281 hours
Chapman 31-15H	33-025-03263	10/14/2017 07:00	10/14/2017 07:00	11/8/2017 05:00	595 hours	Combustion for 595 hours

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Spring 21-15TFH	33-025-03264	11/4/2017 10:00	11/4/2017 10:00	11/20/2017 05:00	399 hours	Combustion for 399 hours
Forsman USA 44-22H	33-053-07703	12/5/2017 09:00	12/5/2017 09:00	12/15/2017 05:00	260 hours	Combustion for 260 hours
Lockwood USA 44-22TFH	33-053-07704	12/10/2017 08:30	12/10/2017 08:30	12/21/2017 05:00	281 hours	Combustion for 281 hours
Lena USA 14-22H	33-053-07922	12/18/2017 01:00	12/18/2017 01:00	12/22/2017 05:00	92 hours	Combustion for 92 hours
Murphy 34-22TFH-2B	33-053-07705	12/13/2017 12:30	12/13/20171 12:30	12/27/2017 05:00	347 hours	Combustion for 347 hours
Veronica 14-22TFH	33-053-06520	12/16/2018 0:00	12/16/2018 0:00	12/27/2018 05:00	269 hours	Combustion for 269 hours
Begola USA 34-22H	33-053-07706	12/22/2017 16:30	12/22/2017 16:30	1/6/2018 05:00	353.5 hours	Combustion for 353.5 hours
Tat USA 14-22H	33-053-06658	12/23/2017 14:00	12/23/2017 14:00	1/6/2018 05:00	345.5 hours	Combustion for 353.5 hours
Tat USA 34-22H	33-053-03182	11/29/2017 13:50	11/29/2017 13:50	1/9/2018 05:00	296.65 hours	Combustion for 296.65 hours
Rough Coulee USA 24-22TFH	33-053-06521	12/29/2017 21:00	12/29/2017 21:00	1/11/2018 05:00	313.5 hours	Combustion for 296.65 hours
Deane USA 24-22H	33-053-06522	12/24/2017 17:00	12/24/2017 17:00	1/16/2018 05:00	516 hours	Combustion for 516 hours
Arkin 44-12TFH	33-025-03294	1/15/2018 08:15	1/15/2018 08:15	1/23/2018 05:00	211.25 hours	Combustion for 211.25 hours
Blue Creek 24-22TFH-2B	33-053-06518	1/18/2018 10:00	1/18/2018 10:00	1/24/2018 05:00	163 hours	Combustion for 163 hours
Bronett 14-7H	33-025-03293	1/24/2018 12:00	1/24/2018 12:00	2/1/2018 05:00	181.75 hours	Gas Sales and Combustion for 181.75

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Ernst 14-7TFH	33-025-03267	1/28/2018 12:15	1/28/2018 12:15	2/12/2018 05:00	366.25 hours	Gas Sales and Combustion for 366.25
Kenneth 24-7TFH	33-025-03268	1/31/2018 13:00	1/31/2018 13:00	2/15/2018 05:00	371 hours	Gas Sales and Combustion for 371 hours
Stroup 34-7TFH	33-025-03270	1/31/2018 13:30	1/31/2018 13:30	2/16/2018 05:00	394.5 hours	Gas Sales and Combustion for 394.5 hours
Bethol 34-7H	33-025-03269	2/9/2017 09:30	2/9/2017 09:30	2/27/2017 05:00	451.5 hours	Gas Sales and Combustion for 451.5 hours
Chauncey USA 31-2H	33-053-07956	3/15/2018 15:00	3/15/2018 15:00	3/29/2018 05:00	315.7 hours	Gas Sales and Combustion for 315.7 hours
June USA 31-2H	33-053-07958	3/18/2018 08:00	3/18/2018 08:00	4/1/2018 05:00	323.25 hours	Gas Sales and Combustion for 323.25 hours
Hunts Along USA 12-1H	33-053-03083	3/26/2018 12:00	3/26/2018 08:00	4/12/2018 05:00	247 hours	Gas Sales and Combustion for 247 hours
Wilbur USA 31-2TFH	33-053-07957	3/30/2018 09:00	3/30/2018 09:00	4/12/2018 05:00	332.5 hours	Gas Sales and Combustion for 332 hours

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Mark USA 11-1H	33-053-07990	3/30/2018 09:00	3/30/2018 09:00	4/12/2018 05:00	333 hours	Combustion for 333 hours
Winona USA 21-2TFH-2B	33-053-07955	4/2/2018 12:00	4/2/2018 12:00	4/16/2018 05:00	348 hours	Gas Sales and Combustion for 348 hours
Shoots USA 41-2H	33-053-07988	4/2/2018 12:00	4/2/2018 12:00	4/17/2018 05:00	373.5 hours	Combustion for 373.5 hour
Miles 41-2TFH-2B	33-053-07959	4/7/2018 07:00	4/7/2018 07:00	4/24/2018 05:00	425 hours	Gas Sales and Combustion for 348 hours
Mamie USA 21-11TFH	33-053-07989	4/14/2018 09:15	4/14/2018 09:15	4/27/2018 05:00	307 hours	Gas Sales and Combustion for 307 hours
Demaray USA 41-2TFH	33-053-07693	4/20/2018 09:00	4/20/2018 09:00	5/2/2018 05:00	272 hours	Gas Sales and Combustion for 272 hours
Bear Den 42-5TFH	33-025-01773	4/24/2018 12:30	4/24/2018 12:30	5/1/2018 08:00	134 hours	Gas Sales and Combustion for 134 hours
Timothy USA 11-1TFH-2B	33-053-07991	4/20/2018 08:30	4/20/2018 08:30	5/30/2018 05:00	947.4 hours	Gas Sales and Combustion for 947.4 hours
Struthers USA 41-5H	33-025-03124	5/2/2018 09:00	5/2/2018 09:00	5/15/2018 05:00	299.5 hours	Combustion for 299.5 hours
Ross 42-5H	33-025-01774	5/4/2018 13:30	5/4/2018 13:30	5/19/2018 05:00	345 hours	Combustion for 345 hours

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Ryan 42-5TFH	33-025-03123	5/15/2018 12:30	5/15/2018 12:30	5/24/2018 05:00	206.5 hours	Combustion for 296.5 hours
Hillesland 31-3TFH	33-025-02792	5/9/2018 18:45	5/9/2018 18:45	5/24/2018 10:00	242.2 5 hours	Combustion for 242.25 hours
Rita 41-3TFH	33-025-03310	5/20/2018 14:00	5/20/2018 14:00	6/3/2018 05:00	327 hours	Combustion for 327 hours
Stanton 41-3H	33-025-03309	5/25/2018 17:15	5/25/2018 17:15	6/9/2018 05:00	347.2 5 hours	Combustion for 347.25 hours
Olea 24-11TFH	33-025-03305	6/2/2018 17:00	6/2/2018 17:00	6/14/2018 12:00	283.0 0 hours	Combustion for 283 hours
Sundby 24-11TFH	33-025-03307	6/4/2018 08:30	6/4/2018 08:30	6/18/2018 05:00	347.5 0 hours	Combustion for 347.50 hours
Marlene 34-11TFH	33-025-03282	6/10/2018 11:00	6/10/2018 11:00	6/21/2018 05:00	258.5 hours	Combustion for 258.5 hours
Hugo 34-11H	33-025-03279	6/21/2018 14:00	6/21/2018 14:00	6/28/2018 05:00	178 hours	Combustion for 178 hours
Chimney Butte 34-11H	33-025-00804	6/6/2018 15:50	6/6/2018 15:50	6/28/2018 13:00	487.5 hours	Combustion for 487.5 hours
Gravel Coulee 14-11TFH	33-025-03311	6/15/2018 12:00	6/15/2018 12:00	7/1/2018 00:00	396 hours	Combustion for 396 hours
McFadden 14-11H	33-025-03304	6/20/2018 14:00	6/20/2018 14:00	7/5/2018 05:00	351 hours	Combustion for 351 hours

Appendix C – Well Completions with Hydraulic Fracturing

Well/Facility Name	API Number	Date and Time Flowback Onset	Date and Time of Flowback to Separator	Date and Time Flowback Ended	Duration of Flowback	Duration and Disposition Recovery/Combustion/ Venting
Morrison 24-11H	33-025-03306	6/18/2018 08:00	6/18/2018 08:00	7/6/2018 05:00	412 hours	Combustion for 412 hours
Gifford 34-11TFH	33-025-03280	6/21/2018 14:00	6/21/2018 14:00	7/7/2018 00:00	394 hours	Combustion for 412 hours
Tipton 34-11H	33-025-03281	6/28/2018 14:00	6/28/2018 14:00	7/7/2018 03:00	201 hours	Combustion for 201 hours
Kattevold USA 14-34TFH	33-061-04052	7/11/2018 07:00	7/11/2018 07:00	7/21/2018 03:00	227.5 hours	Combustion for 227.5 hours
Alexander USA 44-33TFH	33-061-04050	7/7/2018 07:00	7/7/2018 07:00	7/25/2018 05:00	422 hours	Combustion for 422 hours
Pfundheller USA 44-33H	33-061-04051	7/21/2018 14:00	7/21/2018 14:00	7/31/2018 03:00	229 hours	Combustion for 229 hours
Colvin USA 14-34TFH	33-061-03831	7/20/2018 08:00	7/20/2018 08:00	8/1/2018 03:00	298 hours	Combustion for 298 hours
Ranger USA 24-34TFH	33-061-03833	7/23/2018 08:00	7/23/2018 08:00	8/8/2018 05:00	368.5 hours	Combustion for 368 hours
Lois USA 14-34H	33-061-04055	7/27/2018 09:00	7/27/2018 09:00	8/9/2018 05:00	315.75 hours	Combustion for 315.75 hours

Appendix D – Storage Vessel Affected Facilities

Well/Facility Name	Latitude	Longitude
Bingo Pad	(b) (9) [redacted]	(b) (9) [redacted]
Mikkelsen Pad		
Martinez USA Pad		
Ringer Pad		
Eagle USA Pad		
Clarks Creek USA Pad		
Raymond USA Pad		
Goldberg USA Pad		
Ladonna Klatt CTB		
Kermit USA Pad		
Trotter 14-23H		
Pelton 24-31H		
Darcy Pad		
Oneil 24-24H		
Oneil 34-24H		
Marlin 14 Pad		
Mary Hansen 14-9H		
Fred Hansen 34-8H		
Quill 34-11H		
Repp 34-34H		
Oscar Stohler 41-4H		

Appendix D – Storage Vessel Affected Facilities

Well/Facility Name	Latitude	Longitude
Moline Pad	(b) (9) [redacted]	(b) (9) [redacted]
Grady USA Pad	[redacted]	[redacted]
William Kukla CTB	[redacted]	[redacted]
Beck Pad CTB	[redacted]	[redacted]
Big Head Pad (Stark CTB)	[redacted]	[redacted]
Tescher 11-27H	[redacted]	[redacted]
Delia USA Pad	[redacted]	[redacted]
Appledoorn 14-19H	[redacted]	[redacted]
Christensen 34-33H	[redacted]	[redacted]
Chapman CTB	[redacted]	[redacted]
Voigt 11-15H	[redacted]	[redacted]
Kempf Trust 21-14H	[redacted]	[redacted]
TAT USA 34 Pad	[redacted]	[redacted]
Veronica USA Pad	[redacted]	[redacted]
Bethol CTB	[redacted]	[redacted]
Sherman USA Pad	[redacted]	[redacted]
Hunts Along USA Pad	[redacted]	[redacted]
Bear Den Pad	[redacted]	[redacted]
Stohler 41 CTB	[redacted]	[redacted]
Earl Pennington USA Pad (Kattevold CTB)	[redacted]	[redacted]

Appendix E- Storage Vessel Affected Facility VOC Emission Rate Determinations

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Appledoorn 14-19H	Bailey	10/25/2017	0	235.45701
Appledoorn 14-19H	Bailey	10/26/2017	0	660.17224
Appledoorn 14-19H	Bailey	10/27/2017	0	925.41247
Appledoorn 14-19H	Bailey	10/28/2017	20	586.69333
Appledoorn 14-19H	Bailey	10/29/2017	0	609.60465
Appledoorn 14-19H	Bailey	10/30/2017	0	673.71542
Appledoorn 14-19H	Bailey	10/31/2017	0	712.07529
Appledoorn 14-19H	Bailey	11/1/2017	0	723.8894581
Appledoorn 14-19H	Bailey	11/2/2017	0	744.15339
Appledoorn 14-19H	Bailey	11/3/2017	0	794.5719896
Appledoorn 14-19H	Bailey	11/4/2017	0	867.2822222
Appledoorn 14-19H	Bailey	11/5/2017	0	665.2126783
Appledoorn 14-19H	Bailey	11/6/2017	0	762.8264622
Appledoorn 14-19H	Bailey	11/7/2017	0	626.8413788
Appledoorn 14-19H	Bailey	11/8/2017	0	564.757465
Appledoorn 14-19H	Bailey	11/9/2017	0	699.0567161
Appledoorn 14-19H	Bailey	11/10/2017	0	608.6959788
Appledoorn 14-19H	Bailey	11/11/2017	4	573.2978615
Appledoorn 14-19H	Bailey	11/12/2017	0	607.1278464
Appledoorn 14-19H	Bailey	11/13/2017	3	648.4546971
Appledoorn 14-19H	Bailey	11/14/2017	0	637.1506296
Appledoorn 14-19H	Bailey	11/15/2017	0	617.2041761
Appledoorn 14-19H	Bailey	11/16/2017	0	627.0484968
Appledoorn 14-19H	Bailey	11/17/2017	0	631.753366
Appledoorn 14-19H	Bailey	11/18/2017	2	516.739648
Appledoorn 14-19H	Bailey	11/19/2017	2	566.1015671
Appledoorn 14-19H	Bailey	11/20/2017	8	541.7316602
Appledoorn 14-19H	Bailey	11/21/2017	0	634.7707876
Appledoorn 14-19H	Bailey	11/22/2017	8	428.3353633
Appledoorn 14-19H	Bailey	11/23/2017	6.00	646.2398743
	Average -10/25/2017 through 11/23/2017			637.8791374

Appledoorn 14-19H

NSPS OOOOa Applicability Determination for Storage tanks

Appledoorn 14-19H	Well name
637.8791374	Average of first thirty days of production after re-frack, bbl/d
10/18/2017	Date of first production after re-frack
3	Number of oil tanks
7/25/2017	Date of LACT unit installation
0.6	Decline factor
7.22	Storage tank emissions - total
41276-41278	Tank numbers
41278	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Bear Den CTB	Lost Bridge	5/24/2018	0	3401.58
Bear Den CTB	Lost Bridge	5/25/2018	0	3906.50
Bear Den CTB	Lost Bridge	5/26/2018	0	3948.92
Bear Den CTB	Lost Bridge	5/27/2018	0	3723.75
Bear Den CTB	Lost Bridge	5/28/2018	0	2432.83
Bear Den CTB	Lost Bridge	5/29/2018	0	3334.42
Bear Den CTB	Lost Bridge	5/30/2018	0	3188.67
Bear Den CTB	Lost Bridge	5/31/2018	0	2673.17
Bear Den CTB	Lost Bridge	6/1/2018	0	3441.17
Bear Den CTB	Lost Bridge	6/2/2018	0	4320.50
Bear Den CTB	Lost Bridge	6/3/2018	0	4745.42
Bear Den CTB	Lost Bridge	6/4/2018	0	5348.58
Bear Den CTB	Lost Bridge	6/5/2018	0	5032.17
Bear Den CTB	Lost Bridge	6/6/2018	0	4677.33
Bear Den CTB	Lost Bridge	6/7/2018	0	4277.83
Bear Den CTB	Lost Bridge	6/8/2018	0	2955.33
Bear Den CTB	Lost Bridge	6/9/2018	0	2788.75
Bear Den CTB	Lost Bridge	6/10/2018	0	2637.42
Bear Den CTB	Lost Bridge	6/11/2018	0	2670.08
Bear Den CTB	Lost Bridge	6/12/2018	0	2337.17
Bear Den CTB	Lost Bridge	6/13/2018	0	2355.83
Bear Den CTB	Lost Bridge	6/14/2018	0	2510.67
Bear Den CTB	Lost Bridge	6/15/2018	0	2098.23
Bear Den CTB	Lost Bridge	6/16/2018	0	633.19
Bear Den CTB	Lost Bridge	6/17/2018	0	102.58
Bear Den CTB	Lost Bridge	6/18/2018	0	644.65
Bear Den CTB	Lost Bridge	6/19/2018	0	1127.35
Bear Den CTB	Lost Bridge	6/20/2018	0	1254.42
Bear Den CTB	Lost Bridge	6/21/2018	0	2248.25
Bear Den CTB	Lost Bridge	6/22/2018	0	2952.33
	Average 5/24/2018 through 6/22/2018			2925.64

Bear Den 42-5TFH, Ross 42-5H, Ryan 42-5TFH, Struthers USA 41-5H

NSPS OOOOa Applicability Determination for Storage tanks

Bear Den CTB	Facility Name
2925.64	Average of first thirty days of production
5/24/2018	Date of first production
6	Number of oil tanks
	Date of LACT unit installation
0.6	Decline factor
33.12	Storage tank emissions - total
2865-2870	Tank numbers
2868, 2869, 2870	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Beck CTB	Bailey	10/19/2017	0	6012.11
Beck CTB	Bailey	10/20/2017	0	6384.73
Beck CTB	Bailey	10/21/2017	0	6100.23
Beck CTB	Bailey	10/22/2017	0	5416.97
Beck CTB	Bailey	10/23/2017	0	4816.80
Beck CTB	Bailey	10/24/2017	0	5002.95
Beck CTB	Bailey	10/25/2017	0	4988.46
Beck CTB	Bailey	10/26/2017	0	5143.34
Beck CTB	Bailey	10/27/2017	0	4416.71
Beck CTB	Bailey	10/28/2017	0	4267.75
Beck CTB	Bailey	10/29/2017	0	3390.10
Beck CTB	Bailey	10/30/2017	0	3610.42
Beck CTB	Bailey	10/31/2017	0	3810.81
Beck CTB	Bailey	11/1/2017	0	3969.36
Beck CTB	Bailey	11/2/2017	0	4348.81
Beck CTB	Bailey	11/3/2017	0	4103.52
Beck CTB	Bailey	11/4/2017	0	4032.91
Beck CTB	Bailey	11/5/2017	0	3934.85
Beck CTB	Bailey	11/6/2017	0	3707.51
Beck CTB	Bailey	11/7/2017	0	3470.55
Beck CTB	Bailey	11/8/2017	0	3071.96
Beck CTB	Bailey	11/9/2017	0	2046.78
Beck CTB	Bailey	11/10/2017	0	2430.13
Beck CTB	Bailey	11/11/2017	0	2107.18
Beck CTB	Bailey	11/12/2017	0	2592.24
Beck CTB	Bailey	11/13/2017	0	2649.89
Beck CTB	Bailey	11/14/2017	0	2731.80
Beck CTB	Bailey	11/15/2017	0	3223.16
Beck CTB	Bailey	11/16/2017	0	3293.51
Beck CTB	Bailey	11/17/2017	0	3193.65
	Average -10/18/2017 through 11/17/2017			3942.31

BRUSH 24-8H, BECK 24-8H, BECK 14-8H, DOUBLE H 34-8TFH, HAMMEL 44-8TFH, TORRISON 24-8TFH

NSPS OOOOa Applicability Determination for Storage tanks

Beck CTB	Facility Name
3942.31	Average of first thirty days of production after re-frack, bbl/d
10/19/2017	Date of first production after re-frack
12	Number of oil tanks
	Date of LACT unit installation
0.6	Decline factor
44.63	Storage tank emissions - total
43999-44010	Tank numbers
44010	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Bethol CTB	Bailey	2/28/2018	0	6125.02
Bethol CTB	Bailey	3/1/2018	0	6164.34
Bethol CTB	Bailey	3/2/2018	0	5763.22
Bethol CTB	Bailey	3/3/2018	0	6116.90
Bethol CTB	Bailey	3/4/2018	0	7193.13
Bethol CTB	Bailey	3/5/2018	0	5105.13
Bethol CTB	Bailey	3/6/2018	0	4244.16
Bethol CTB	Bailey	3/7/2018	0	5234.41
Bethol CTB	Bailey	3/8/2018	0	6031.55
Bethol CTB	Bailey	3/9/2018	0	6257.75
Bethol CTB	Bailey	3/10/2018	0	6201.51
Bethol CTB	Bailey	3/11/2018	0	5988.25
Bethol CTB	Bailey	3/12/2018	0	4460.98
Bethol CTB	Bailey	3/13/2018	0	5104.13
Bethol CTB	Bailey	3/14/2018	0	3247.28
Bethol CTB	Bailey	3/15/2018	0	4604.32
Bethol CTB	Bailey	3/16/2018	0	4673.29
Bethol CTB	Bailey	3/17/2018	0	5799.98
Bethol CTB	Bailey	3/18/2018	0	6177.99
Bethol CTB	Bailey	3/19/2018	0	6641.19
Bethol CTB	Bailey	3/20/2018	0	4710.10
Bethol CTB	Bailey	3/21/2018	0	5028.89
Bethol CTB	Bailey	3/22/2018	0	6592.19
Bethol CTB	Bailey	3/23/2018	0	6117.85
Bethol CTB	Bailey	3/24/2018	0	5574.20
Bethol CTB	Bailey	3/25/2018	0	6247.06
Bethol CTB	Bailey	3/26/2018	0	7258.50
Bethol CTB	Bailey	3/27/2018	0	4914.15
Bethol CTB	Bailey	3/28/2018	0	7001.68
Bethol CTB	Bailey	3/29/2018	0	6240.59
	Average 12/15/2017 through 1/13/7/2018			5693.99

Bethol 34-7H, Stroup 34-7TFH, Kenneth 24-7TFH, Ernst 14-7TFH, Bronnett 14-7H, Arkin 44-1TFH, and Kevin Buehner 31-18H
NSPS OOOOa Applicability Determination for Storage tanks

Bethol CTB	Facility Name
5693.99	Average of first thirty days of production
2/28/2018	Date of first production
16	Number of oil tanks
	Date of LACT unit installation
0.6	Decline factor
64.46	Storage tank emissions - total
44021-44036	Tank numbers
44029, 44035, 44036	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Chapman CTB		11/21/2017	0	2361.84
Chapman CTB	Reunion Bay	11/22/2017	0	2330.10
Chapman CTB	Reunion Bay	11/23/2017	0	2236.65
Chapman CTB	Reunion Bay	11/24/2017	0	2114.27
Chapman CTB	Reunion Bay	11/25/2017	0	2071.35
Chapman CTB	Reunion Bay	11/26/2017	0	1863.71
Chapman CTB	Reunion Bay	11/27/2017	0	1741.24
Chapman CTB	Reunion Bay	11/28/2017	0	1624.49
Chapman CTB	Reunion Bay	11/29/2017	0	1661.80
Chapman CTB	Reunion Bay	11/30/2017	0	1662.53
Chapman CTB	Reunion Bay	12/1/2017	0	1636.66
Chapman CTB	Reunion Bay	12/2/2017	0	1610.95
Chapman CTB	Reunion Bay	12/3/2017	0	1575.44
Chapman CTB	Reunion Bay	12/4/2017	0	1579.96
Chapman CTB	Reunion Bay	12/5/2017	0	1575.26
Chapman CTB	Reunion Bay	12/6/2017	0	1509.68
Chapman CTB	Reunion Bay	12/7/2017	0	903.78
Chapman CTB	Reunion Bay	12/8/2017	0	842.75
Chapman CTB	Reunion Bay	12/9/2017	0	1573.09
Chapman CTB	Reunion Bay	12/10/2017	0	1702.87
Chapman CTB	Reunion Bay	12/11/2017	0	1428.51
Chapman CTB	Reunion Bay	12/12/2017	0	1517.18
Chapman CTB	Reunion Bay	12/13/2017	0	1366.16
Chapman CTB	Reunion Bay	12/14/2017	0	1404.64
Chapman CTB	Reunion Bay	12/15/2017	0	1578.95
Chapman CTB	Reunion Bay	12/16/2017	0	1592.93
Chapman CTB	Reunion Bay	12/17/2017	0	1507.10
Chapman CTB	Reunion Bay	12/18/2017	0	1510.89
Chapman CTB	Reunion Bay	12/19/2017	0	1141.23
Chapman CTB	Reunion Bay	12/20/2017	0	1791.16
	Average -11/21/2017 through 12/20/2017			1633.91

NSPS OOOOa Applicability Determination for Storage tanks

Chapman CTB	Facility Name
1633.91	Average of first thirty days of production after re-frack, bbl/d
11/21/2017	Date of first production after re-frack
9	Number of oil tanks
11/21/2017	Date of LACT unit installation
0.6	Decline factor
18.50	Storage tank emissions - total
44011-44019	Tank numbers
44015, 44019	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Christensen 34-33H	Bailey	10/18/2017	0	627.60
Christensen 34-33H	Bailey	10/19/2017	0	909.05
Christensen 34-33H	Bailey	10/20/2017	0	773.21
Christensen 34-33H	Bailey	10/21/2017	0	772.87
Christensen 34-33H	Bailey	10/22/2017	0	789.44
Christensen 34-33H	Bailey	10/23/2017	0	767.62
Christensen 34-33H	Bailey	10/24/2017	0	801.41
Christensen 34-33H	Bailey	10/25/2017	0	758.89
Christensen 34-33H	Bailey	10/26/2017	0	766.04
Christensen 34-33H	Bailey	10/27/2017	0	746.51
Christensen 34-33H	Bailey	10/28/2017	0	726.60
Christensen 34-33H	Bailey	10/29/2017	0	729.62
Christensen 34-33H	Bailey	10/30/2017	0	717.95
Christensen 34-33H	Bailey	10/31/2017	0	698.09
Christensen 34-33H	Bailey	11/1/2017	0	684.06
Christensen 34-33H	Bailey	11/2/2017	0	671.03
Christensen 34-33H	Bailey	11/3/2017	0	670.52
Christensen 34-33H	Bailey	11/4/2017	0	665.21
Christensen 34-33H	Bailey	11/5/2017	0	735.71
Christensen 34-33H	Bailey	11/6/2017	0	596.50
Christensen 34-33H	Bailey	11/7/2017	0	640.64
Christensen 34-33H	Bailey	11/8/2017	0	634.36
Christensen 34-33H	Bailey	11/9/2017	0	625.95
Christensen 34-33H	Bailey	11/10/2017	0	630.86
Christensen 34-33H	Bailey	11/11/2017	0	605.19
Christensen 34-33H	Bailey	11/12/2017	0	606.80
Christensen 34-33H	Bailey	11/13/2017	0	575.66
Christensen 34-33H	Bailey	11/14/2017	0	575.54
Christensen 34-33H	Bailey	11/15/2017	0	559.31
Christensen 34-33H	Bailey	11/16/2017	0	562.29
	Average -10/18/2017 through 11/16/2017			687.48

Christensen 34-33H

NSPS OOOOa Applicability Determination for Storage tanks

Christensen 34-33H	Well name
687.48	Average of first thirty days of production after re-frack, bbl/d
10/18/2017	Date of first production after re-frack
3	Number of oil tanks
	Date of LACT unit Installation
1	Decline factor
12.97	Storage tank emissions - total
41401-41403	Tank numbers
41403	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Delia CTB	Bailey	10/2/2017	0	2934.25
Delia CTB	Bailey	10/3/2017	0	4603.11
Delia CTB	Bailey	10/4/2017	0	4676.30
Delia CTB	Bailey	10/5/2017	0	4311.03
Delia CTB	Bailey	10/6/2017	0	4001.92
Delia CTB	Bailey	10/7/2017	0	3930.02
Delia CTB	Bailey	10/8/2017	0	3516.95
Delia CTB	Bailey	10/9/2017	0	3600.39
Delia CTB	Bailey	10/10/2017	0	3710.92
Delia CTB	Bailey	10/11/2017	0	3374.35
Delia CTB	Bailey	10/12/2017	0	3289.91
Delia CTB	Bailey	10/13/2017	0	3194.64
Delia CTB	Bailey	10/14/2017	0	3108.42
Delia CTB	Bailey	10/15/2017	0	2641.46
Delia CTB	Bailey	10/16/2017	0	2848.22
Delia CTB	Bailey	10/17/2017	0	3164.72
Delia CTB	Bailey	10/18/2017	0	1822.49
Delia CTB	Bailey	10/19/2017	0	1384.74
Delia CTB	Bailey	10/20/2017	0	1279.69
Delia CTB	Bailey	10/21/2017	0	1556.07
Delia CTB	Bailey	10/22/2017	0	2336.51
Delia CTB	Bailey	10/23/2017	0	2771.38
Delia CTB	Bailey	10/24/2017	0	2261.25
Delia CTB	Bailey	10/25/2017	0	2844.31
Delia CTB	Bailey	10/26/2017	0	2762.46
Delia CTB	Bailey	10/27/2017	0	2654.60
Delia CTB	Bailey	10/28/2017	0	2562.93
Delia CTB	Bailey	10/29/2017	0	2483.98
Delia CTB	Bailey	10/30/2017	0	2328.63
Delia CTB	Bailey	10/31/2017	0	2372.99
	Average -10/2/2017 through 11/17/2017			2944.29

Delia USA 14-9TFH, Clarice USA 14-9H

NSPS OOOOa Applicability Determination for Storage tanks

Delia CTB	Facility Name
2944.29	Average of first thirty days of production after re-frack, bbl/d
10/2/2017	Date of first production after re-frack
3	Number of oil tanks
10/2/2017	Date of LACT unit installation
0.6	Decline factor
33.33	Storage tank emissions - total
43544-43549	Tank numbers
43548	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
KATTEVOLD USA CTB	Reunuin Bay	8/1/2018	0	4711.86
KATTEVOLD USA CTB	Reunuin Bay	8/2/2018	0	5734.97
KATTEVOLD USA CTB	Reunuin Bay	8/3/2018	0	4726.78
KATTEVOLD USA CTB	Reunuin Bay	8/4/2018	0	5987.60
KATTEVOLD USA CTB	Reunuin Bay	8/5/2018	0	6177.23
KATTEVOLD USA CTB	Reunuin Bay	8/6/2018	0	5341.88
KATTEVOLD USA CTB	Reunuin Bay	8/7/2018	0	6119.18
KATTEVOLD USA CTB	Reunuin Bay	8/8/2018	0	4568.80
KATTEVOLD USA CTB	Reunuin Bay	8/9/2018	0	4934.29
KATTEVOLD USA CTB	Reunuin Bay	8/10/2018	0	2601.39
KATTEVOLD USA CTB	Reunuin Bay	8/11/2018	0	1895.35
KATTEVOLD USA CTB	Reunuin Bay	8/12/2018	0	1961.98
KATTEVOLD USA CTB	Reunuin Bay	8/13/2018	0	1436.23
KATTEVOLD USA CTB	Reunuin Bay	8/14/2018	0	1477.17
KATTEVOLD USA CTB	Reunuin Bay	8/15/2018	0	1636.88
KATTEVOLD USA CTB	Reunuin Bay	8/16/2018	0	1486.73
KATTEVOLD USA CTB	Reunuin Bay	8/17/2018	0	1030.18
KATTEVOLD USA CTB	Reunuin Bay	8/18/2018	0	1529.05
KATTEVOLD USA CTB	Reunuin Bay	8/19/2018	0	1577.30
KATTEVOLD USA CTB	Reunuin Bay	8/20/2018	0	2457.93
KATTEVOLD USA CTB	Reunuin Bay	8/21/2018	0	2750.49
KATTEVOLD USA CTB	Reunuin Bay	8/22/2018	0	2918.10
KATTEVOLD USA CTB	Reunuin Bay	8/23/2018	0	2641.30
KATTEVOLD USA CTB	Reunuin Bay	8/24/2018	0	3280.57
KATTEVOLD USA CTB	Reunuin Bay	8/25/2018	0	6253.80
KATTEVOLD USA CTB	Reunuin Bay	8/26/2018	0	6174.07
KATTEVOLD USA CTB	Reunuin Bay	8/27/2018	0	5695.16
KATTEVOLD USA CTB	Reunuin Bay	8/28/2018	0	5132.99
KATTEVOLD USA CTB	Reunuin Bay	8/29/2018	0	5264.55
KATTEVOLD USA CTB	Reunuin Bay	8/30/2018	0	5054.32
	Average 8/1/2018 through 8/30/2018			3751.94

KATTEVOLD USA 14-34TFH, ALEXANDER USA 44-33TFH, PFUNDHELLER USA 44-33H

NSPS OOOOa Applicability Determination for Storage tanks

Earl Pennington Pad/ KATTEVOLD USA CTB	Facility Name
3751.94	Average of first thirty days of production
8/1/2018	Date of first production
7	Number of oil tanks
0.5	Decline factor
30.39	Storage tank emissions - total
2888-2894	Tank numbers
2889, 2891, 2893, 2894,	LACT permissive tank

Completion Name	Field	Date	Down Time Hours	Actual Oil Production
Hunts Along USA CTB	Antelope	5/31/2018	0	282.72
Hunts Along USA CTB	Antelope	6/1/2018	0	8702.27
Hunts Along USA CTB	Antelope	6/2/2018	0	8864.40
Hunts Along USA CTB	Antelope	6/3/2018	0	5868.86
Hunts Along USA CTB	Antelope	6/4/2018	0	5485.74
Hunts Along USA CTB	Antelope	6/5/2018	0	5274.59
Hunts Along USA CTB	Antelope	6/6/2018	0	5419.94
Hunts Along USA CTB	Antelope	6/7/2018	0	7191.69
Hunts Along USA CTB	Antelope	6/8/2018	0	8788.62
Hunts Along USA CTB	Antelope	6/9/2018	0	9342.04
Hunts Along USA CTB	Antelope	6/10/2018	0	8264.17
Hunts Along USA CTB	Antelope	6/11/2018	0	6638.05
Hunts Along USA CTB	Antelope	6/12/2018	0	5020.03
Hunts Along USA CTB	Antelope	6/13/2018	0	4428.58
Hunts Along USA CTB	Antelope	6/14/2018	0	6431.83
Hunts Along USA CTB	Antelope	6/15/2018	0	7913.93
Hunts Along USA CTB	Antelope	6/16/2018	0	9210.29
Hunts Along USA CTB	Antelope	6/17/2018	0	10310.95
Hunts Along USA CTB	Antelope	6/18/2018	0	7177.00
Hunts Along USA CTB	Antelope	6/19/2018	0	9545.47
Hunts Along USA CTB	Antelope	6/20/2018	0	8709.27
Hunts Along USA CTB	Antelope	6/21/2018	0	9246.99
Hunts Along USA CTB	Antelope	6/22/2018	0	8858.00
Hunts Along USA CTB	Antelope	6/23/2018	0	8694.51
Hunts Along USA CTB	Antelope	6/24/2018	0	8734.81
Hunts Along USA CTB	Antelope	6/25/2018	0	8145.49
Hunts Along USA CTB	Antelope	6/26/2018	0	8190.63
Hunts Along USA CTB	Antelope	6/27/2018	0	8015.16
Hunts Along USA CTB	Antelope	6/28/2018	0	7660.08
Hunts Along USA CTB	Antelope	6/29/2018	0	7836.45
	Average 5/31/2018 through 6/29/2018			7475.09

Hunts Along USA 12-1H, Mamie USA 21-1TFH, Mark USA 11-1H, and Timothy USA 11-1TFH-2B, Shoots USA 41-2H, Demaray USA 41-2TFH

NSPS OOOOa Applicability Determination for Storage tanks

Hunts Along USA Pad	Facility Name
7475.09	Average of first thirty days of production
5/31/2018	Date of first production
14	Number of oil tanks
	Date of LACT unit installation
0.5	Decline factor
60.55	Storage tank emissions - total
2871-2883, 2887	Tank numbers
2874, 2875, 2878, 2880, 2882	LACT permissive tanks

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Kempf Trust 21-14H	Bailey	11/6/2017	0	573.42
Kempf Trust 21-14H	Bailey	11/7/2017	0	788.66
Kempf Trust 21-14H	Bailey	11/8/2017	0	759.78
Kempf Trust 21-14H	Bailey	11/9/2017	0	707.71
Kempf Trust 21-14H	Bailey	11/10/2017	0	692.57
Kempf Trust 21-14H	Bailey	11/11/2017	0	632.97
Kempf Trust 21-14H	Bailey	11/12/2017	0	654.72
Kempf Trust 21-14H	Bailey	11/13/2017	0	595.41
Kempf Trust 21-14H	Bailey	11/14/2017	0	617.24
Kempf Trust 21-14H	Bailey	11/15/2017	0	580.39
Kempf Trust 21-14H	Bailey	11/16/2017	0	567.81
Kempf Trust 21-14H	Bailey	11/17/2017	0	570.63
Kempf Trust 21-14H	Bailey	11/18/2017	0	539.23
Kempf Trust 21-14H	Bailey	11/19/2017	0	555.01
Kempf Trust 21-14H	Bailey	11/20/2017	0	560.53
Kempf Trust 21-14H	Bailey	11/21/2017	0	569.51
Kempf Trust 21-14H	Bailey	11/22/2017	0	554.41
Kempf Trust 21-14H	Bailey	11/23/2017	0	609.57
Kempf Trust 21-14H	Bailey	11/24/2017	0	620.35
Kempf Trust 21-14H	Bailey	11/25/2017	0	597.93
Kempf Trust 21-14H	Bailey	11/26/2017	0	595.06
Kempf Trust 21-14H	Bailey	11/27/2017	0	573.34
Kempf Trust 21-14H	Bailey	11/28/2017	0	567.27
Kempf Trust 21-14H	Bailey	11/29/2017	0	559.38
Kempf Trust 21-14H	Bailey	11/30/2017	0	536.39
Kempf Trust 21-14H	Bailey	12/1/2017	0	542.31
Kempf Trust 21-14H	Bailey	12/2/2017	0	536.47
Kempf Trust 21-14H	Bailey	12/3/2017	0	514.87
Kempf Trust 21-14H	Bailey	12/4/2017	0	508.53
Kempf Trust 21-14H	Bailey	12/5/2017	0	500.71
	Average -10/31/2017 through 11/29/2017			592.74

Kempf Trust 21-14H

NSPS OOOOa Applicability Determination for Storage tanks

Kempf Trust 21-14H	Well name
592.74	Average of first thirty days of production after re-frack, bbl/d
10/31/2017	Date of first production after re-frack
3	Number of oil tanks
9/27/2017	Date of LACT unit installation
1	Decline factor
11.19	Storage tank emissions - total
41658-41660	Tank numbers
41660	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Veronica USA CTB	Antelope	1/25/2018	0	9944.45
Veronica USA CTB	Antelope	1/26/2018	0	9454.80
Veronica USA CTB	Antelope	1/27/2018	0	9112.89
Veronica USA CTB	Antelope	1/28/2018	0	9183.73
Veronica USA CTB	Antelope	1/29/2018	0	9540.03
Veronica USA CTB	Antelope	1/30/2018	0	9476.08
Veronica USA CTB	Antelope	1/31/2018	0	9958.40
Veronica USA CTB	Antelope	2/1/2018	0	8248.78
Veronica USA CTB	Antelope	2/2/2018	0	4613.06
Veronica USA CTB	Antelope	2/3/2018	0	4520.94
Veronica USA CTB	Antelope	2/4/2018	0	3556.49
Veronica USA CTB	Antelope	2/5/2018	0	3606.44
Veronica USA CTB	Antelope	2/6/2018	0	4333.97
Veronica USA CTB	Antelope	2/7/2018	0	5076.18
Veronica USA CTB	Antelope	2/8/2018	0	4843.84
Veronica USA CTB	Antelope	2/9/2018	0	4697.06
Veronica USA CTB	Antelope	2/10/2018	0	4587.03
Veronica USA CTB	Antelope	2/11/2018	0	4420.82
Veronica USA CTB	Antelope	2/12/2018	0	4527.99
Veronica USA CTB	Antelope	2/13/2018	0	4777.86
Veronica USA CTB	Antelope	2/14/2018	0	5477.97
Veronica USA CTB	Antelope	2/15/2018	0	6518.27
Veronica USA CTB	Antelope	2/16/2018	0	6687.84
Veronica USA CTB	Antelope	2/17/2018	0	6525.28
Veronica USA CTB	Antelope	2/18/2018	0	5369.58
Veronica USA CTB	Antelope	2/19/2018	0	5560.02
Veronica USA CTB	Antelope	2/20/2018	0	5955.73
Veronica USA CTB	Antelope	2/21/2018	0	5667.58
Veronica USA CTB	Antelope	2/22/2018	0	4265.76
Veronica USA CTB	Antelope	2/23/2018	0	4606.03
	Average 12/15/2017 through 1/13/7/2018			6170.50

Blue Creek USA 24-22TFH-2B, Deane USA 24-22H, Rough Coulee USA 24-22TFH, TAT USA 14-22H, Veronica USA 14-22TF, Lena USA 14-22H

NSPS OOOOa Applicability Determination for Storage tanks

	Veronica USA Pad	Facility Name
	6170.50	Average of first thirty days of production
	1/25/2018	Date of first production
	21	Number of oil tanks
		Date of LACT unit installation
	0.5	Decline factor
	49.98	Storage tank emissions - total
	2821-2841	Tank numbers
2824, 2425,2834, 2840, 2841		LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Sherman USA CTB	Antelope	4/24/2018	0	5571.09
Sherman USA CTB	Antelope	4/25/2018	0	5362.58
Sherman USA CTB	Antelope	4/26/2018	0	7728.89
Sherman USA CTB	Antelope	4/27/2018	0	9876.11
Sherman USA CTB	Antelope	4/28/2018	0	11161.88
Sherman USA CTB	Antelope	4/29/2018	0	11019.61
Sherman USA CTB	Antelope	4/30/2018	0	11490.46
Sherman USA CTB	Antelope	5/1/2018	0	10207.29
Sherman USA CTB	Antelope	5/2/2018	0	10520.86
Sherman USA CTB	Antelope	5/3/2018	0	10507.29
Sherman USA CTB	Antelope	5/4/2018	0	10738.72
Sherman USA CTB	Antelope	5/5/2018	0	10042.06
Sherman USA CTB	Antelope	5/6/2018	0	9909.17
Sherman USA CTB	Antelope	5/7/2018	0	10764.07
Sherman USA CTB	Antelope	5/8/2018	0	10897.38
Sherman USA CTB	Antelope	5/9/2018	0	10342.89
Sherman USA CTB	Antelope	5/10/2018	0	10036.36
Sherman USA CTB	Antelope	5/11/2018	0	9455.08
Sherman USA CTB	Antelope	5/12/2018	0	9706.27
Sherman USA CTB	Antelope	5/13/2018	0	9777.00
Sherman USA CTB	Antelope	5/14/2018	0	10006.27
Sherman USA CTB	Antelope	5/15/2018	0	9898.41
Sherman USA CTB	Antelope	5/16/2018	0	9009.41
Sherman USA CTB	Antelope	5/17/2018	0	9728.87
Sherman USA CTB	Antelope	5/18/2018	0	9658.28
Sherman USA CTB	Antelope	5/19/2018	0	9416.53
Sherman USA CTB	Antelope	5/20/2018	0	8821.56
Sherman USA CTB	Antelope	5/21/2018	0	7920.40
Sherman USA CTB	Antelope	5/22/2018	0	6688.38
Sherman USA CTB	Antelope	5/23/2018	0	8104.85
	Average 4/24/2018 through 5/23/2018			9478.93

Winona USA 21-2TFH-2B, Chauncey USA 31-2H, Wilbur USA 31-2TFH, June USA 31-2H, Miles USA 41-2TFH-2B

NSPS OOOOa Applicability Determination for Storage tanks

Hunts Along USA Pad	Facility Name
9478.93	Average of first thirty days of production
4/24/2018	Date of first production
9	Number of oil tanks
	Date of LACT unit installation
0.5	Decline factor
76.79	Storage tank emissions - total
2856-2864	Tank numbers
2860, 2862, 2864	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Stark CTB	Reunion Bay	10/27/2017	0	6739.65
Stark CTB	Reunion Bay	10/28/2017	0	6542.82
Stark CTB	Reunion Bay	10/29/2017	0	6360.04
Stark CTB	Reunion Bay	10/30/2017	0	5979.75
Stark CTB	Reunion Bay	10/31/2017	0	5823.56
Stark CTB	Reunion Bay	11/1/2017	0	5848.13
Stark CTB	Reunion Bay	11/2/2017	0	5735.86
Stark CTB	Reunion Bay	11/3/2017	0	5605.41
Stark CTB	Reunion Bay	11/4/2017	0	5456.91
Stark CTB	Reunion Bay	11/5/2017	0	5303.25
Stark CTB	Reunion Bay	11/6/2017	0	5176.33
Stark CTB	Reunion Bay	11/7/2017	0	5181.08
Stark CTB	Reunion Bay	11/8/2017	0	4795.99
Stark CTB	Reunion Bay	11/9/2017	0	4926.49
Stark CTB	Reunion Bay	11/10/2017	0	4194.50
Stark CTB	Reunion Bay	11/11/2017	0	4130.83
Stark CTB	Reunion Bay	11/12/2017	0	4008.00
Stark CTB	Reunion Bay	11/13/2017	0	3876.51
Stark CTB	Reunion Bay	11/14/2017	0	3568.29
Stark CTB	Reunion Bay	11/15/2017	0	136.92
Stark CTB	Reunion Bay	11/16/2017	0	92.92
Stark CTB	Reunion Bay	11/17/2017	0	0.00
Stark CTB	Reunion Bay	11/18/2017	0	0.00
Stark CTB	Reunion Bay	11/19/2017	0	0.00
Stark CTB	Reunion Bay	11/20/2017	0	95.00
Stark CTB	Reunion Bay	11/21/2017	0	1346.92
Stark CTB	Reunion Bay	11/22/2017	0	3293.60
Stark CTB	Reunion Bay	11/23/2017	0	2806.21
Stark CTB	Reunion Bay	11/24/2017	0	2930.30
Stark CTB	Reunion Bay	11/25/2017	0	981.98
	Average -10/2/2017 through 10/30/2017			3697.91

NSPS OOOOa Applicability Determination for Storage tanks

Stark CTB	Facility Name
3697.91	Average of first thirty days of production after re-frack, bbl/d
10/27/2017	Date of first production after re-frack
14	Number of oil tanks
10/27/2017	Date of LACT unit installation
0.5	Decline factor
34.89	Storage tank emissions - total
2842-2855	Tank numbers
2849, 2854	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Stohler 41 CTB	Bailey	6/10/2018	0	4673.13
Stohler 41 CTB	Bailey	6/11/2018	0	4559.27
Stohler 41 CTB	Bailey	6/12/2018	0	4517.16
Stohler 41 CTB	Bailey	6/13/2018	0	4450.30
Stohler 41 CTB	Bailey	6/14/2018	0	3605.16
Stohler 41 CTB	Bailey	6/15/2018	0	1813.92
Stohler 41 CTB	Bailey	6/16/2018	0	1369.48
Stohler 41 CTB	Bailey	6/17/2018	0	1363.52
Stohler 41 CTB	Bailey	6/18/2018	0	1406.12
Stohler 41 CTB	Bailey	6/19/2018	0	1246.44
Stohler 41 CTB	Bailey	6/20/2018	0	409.45
Stohler 41 CTB	Bailey	6/21/2018	0	9.38
Stohler 41 CTB	Bailey	6/22/2018	0	617.25
Stohler 41 CTB	Bailey	6/23/2018	0	248.78
Stohler 41 CTB	Bailey	6/24/2018	0	35.19
Stohler 41 CTB	Bailey	6/25/2018	0	1117.59
Stohler 41 CTB	Bailey	6/26/2018	0	1259.84
Stohler 41 CTB	Bailey	6/27/2018	0	1371.83
Stohler 41 CTB	Bailey	6/28/2018	0	1164.07
Stohler 41 CTB	Bailey	6/29/2018	0	1.00
Stohler 41 CTB	Bailey	6/30/2018	0	297.35
Stohler 41 CTB	Bailey	7/1/2018	0	1999.11
Stohler 41 CTB	Bailey	7/2/2018	0	1675.04
Stohler 41 CTB	Bailey	7/3/2018	0	1818.37
Stohler 41 CTB	Bailey	7/4/2018	0	2213.93
Stohler 41 CTB	Bailey	7/5/2018	0	3274.92
Stohler 41 CTB	Bailey	7/6/2018	0	4241.81
Stohler 41 CTB	Bailey	7/7/2018	0	4557.92
Stohler 41 CTB	Bailey	7/8/2018	0	4979.08
Stohler 41 CTB	Bailey	7/9/2018	0	4567.04
	Average 6/10/2018 through 7/9/2018			4418.75

Stohler 21-3H, Stohler 41-3H, Hillesland 31-3TFH, Rita 41-3TFH, and Stanton 41-3H

NSPS OOOOa Applicability Determination for Storage tanks

Stohler 41 CTB	Facility Name
4418.75	Average of first thirty days of production
6/10/2018	Date of first production
6	Number of oil tanks
	Date of LACT unit installation
0.6	Decline factor
50.03	Storage tank emissions - total
44046-44051	Tank numbers
44048	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
Tescher 11-27H	Bailey	10/2/2017	0	1054.13
Tescher 11-27H	Bailey	10/3/2017	0	1066.74
Tescher 11-27H	Bailey	10/4/2017	0	1031.04
Tescher 11-27H	Bailey	10/5/2017	0	1039.66
Tescher 11-27H	Bailey	10/6/2017	0	1022.99
Tescher 11-27H	Bailey	10/7/2017	0	1014.55
Tescher 11-27H	Bailey	10/8/2017	0	980.09
Tescher 11-27H	Bailey	10/9/2017	0	964.79
Tescher 11-27H	Bailey	10/10/2017	0	959.47
Tescher 11-27H	Bailey	10/11/2017	0	862.50
Tescher 11-27H	Bailey	10/12/2017	0	984.25
Tescher 11-27H	Bailey	10/13/2017	0	1018.64
Tescher 11-27H	Bailey	10/14/2017	0	981.53
Tescher 11-27H	Bailey	10/15/2017	0	1001.35
Tescher 11-27H	Bailey	10/16/2017	0	1009.31
Tescher 11-27H	Bailey	10/17/2017	0	962.31
Tescher 11-27H	Bailey	10/18/2017	0	953.40
Tescher 11-27H	Bailey	10/19/2017	0	930.40
Tescher 11-27H	Bailey	10/20/2017	0	909.73
Tescher 11-27H	Bailey	10/21/2017	0	905.18
Tescher 11-27H	Bailey	10/22/2017	0	879.61
Tescher 11-27H	Bailey	10/23/2017	0	862.03
Tescher 11-27H	Bailey	10/24/2017	0	845.35
Tescher 11-27H	Bailey	10/25/2017	0	831.96
Tescher 11-27H	Bailey	10/26/2017	0	823.66
Tescher 11-27H	Bailey	10/27/2017	0	808.49
Tescher 11-27H	Bailey	10/28/2017	0	792.15
Tescher 11-27H	Bailey	10/29/2017	0	777.14
Tescher 11-27H	Bailey	10/30/2017	0	780.83
Tescher 11-27H	Bailey	10/31/2017	0	761.44
	Average -10/2/2017 through 10/31/2017			927.16

Tescher 11-27H

NSPS OOOOa Applicability Determination for Storage tanks

Tescher 11-27H	Well name
927.1581097	Average of first thirty days of production after re-frack, bbl/d
8/29/2017	Date of first production after re-frack
3	Number of oil tanks
	Date of LACT unit installation
1	Decline factor
17.50	Storage tank emissions - total
41915-41917	Tank numbers
41917	LACT permissive tank

Completion Name	Field	Date	Actual Oil Production
Voight 11-15H	Murphy Creek	10/30/2017	337.53
Voight 11-15H	Murphy Creek	10/31/2017	573.42
Voight 11-15H	Murphy Creek	11/1/2017	788.66
Voight 11-15H	Murphy Creek	11/2/2017	759.78
Voight 11-15H	Murphy Creek	11/3/2017	707.71
Voight 11-15H	Murphy Creek	11/4/2017	692.57
Voight 11-15H	Murphy Creek	11/5/2017	632.97
Voight 11-15H	Murphy Creek	11/6/2017	654.72
Voight 11-15H	Murphy Creek	11/7/2017	595.41
Voight 11-15H	Murphy Creek	11/8/2017	617.24
Voight 11-15H	Murphy Creek	11/9/2017	580.39
Voight 11-15H	Murphy Creek	11/10/2017	567.81
Voight 11-15H	Murphy Creek	11/11/2017	570.63
Voight 11-15H	Murphy Creek	11/12/2017	539.23
Voight 11-15H	Murphy Creek	11/13/2017	555.01
Voight 11-15H	Murphy Creek	11/14/2017	560.53
Voight 11-15H	Murphy Creek	11/15/2017	569.51
Voight 11-15H	Murphy Creek	11/16/2017	554.41
Voight 11-15H	Murphy Creek	11/17/2017	609.57
Voight 11-15H	Murphy Creek	11/18/2017	620.35
Voight 11-15H	Murphy Creek	11/19/2017	597.93
Voight 11-15H	Murphy Creek	11/20/2017	595.06
Voight 11-15H	Murphy Creek	11/21/2017	573.34
Voight 11-15H	Murphy Creek	11/22/2017	567.27
Voight 11-15H	Murphy Creek	11/23/2017	559.38
Voight 11-15H	Murphy Creek	11/24/2017	536.39
Voight 11-15H	Murphy Creek	11/25/2017	542.31
Voight 11-15H	Murphy Creek	11/26/2017	536.47
Voight 11-15H	Murphy Creek	11/27/2017	514.87
Voight 11-15H	Murphy Creek	11/28/2017	508.53
	Average -10/30/2017 through 11/28/2017		587.30

Voight 11-15H

NSPS OOOOa Applicability Determination for Storage tanks

Voight 11-15H	Well name
587.30	Average of first thirty days of production after re-frack, bbl/d
10/30/2017	Date of first production after re-frack
3	Number of oil tanks
	Date of LACT unit installation
1	Decline factor
11.08	Storage tank emissions - total
41288-41290	Tank numbers
41290	LACT permissive tank

Completion Name	Field	Date	Down Time Hours(1)	Actual Oil Production
KUKLA 34-34H	Murphy Creek	9/23/2017	10	427.01
KUKLA 34-34H	Murphy Creek	9/24/2017	0	468.11
KUKLA 34-34H	Murphy Creek	9/25/2017	0	457.48
KUKLA 34-34H	Murphy Creek	9/26/2017	0	482.70
KUKLA 34-34H	Murphy Creek	9/27/2017	0	475.53
KUKLA 34-34H	Murphy Creek	9/28/2017	0	325.51
KUKLA 34-34H	Murphy Creek	9/29/2017	0	73.79
KUKLA 34-34H	Murphy Creek	9/30/2017	0	47.20
KUKLA 34-34H	Murphy Creek	10/1/2017	0	110.64
KUKLA 34-34H	Murphy Creek	10/2/2017	0	601.56
KUKLA 34-34H	Murphy Creek	10/3/2017	0	457.51
KUKLA 34-34H	Murphy Creek	10/4/2017	0	650.40
KUKLA 34-34H	Murphy Creek	10/5/2017	0	596.03
KUKLA 34-34H	Murphy Creek	10/6/2017	0	534.02
KUKLA 34-34H	Murphy Creek	10/7/2017	0	518.62
KUKLA 34-34H	Murphy Creek	10/8/2017	0	489.99
KUKLA 34-34H	Murphy Creek	10/9/2017	0	478.78
KUKLA 34-34H	Murphy Creek	10/10/2017	10	472.53
KUKLA 34-34H	Murphy Creek	10/11/2017	24	449.09
KUKLA 34-34H	Murphy Creek	10/12/2017	23	441.75
KUKLA 34-34H	Murphy Creek	10/13/2017	23	430.35
KUKLA 34-34H	Murphy Creek	10/14/2017	23	416.86
KUKLA 34-34H	Murphy Creek	10/15/2017	24	407.41
KUKLA 34-34H	Murphy Creek	10/16/2017	24	399.66
KUKLA 34-34H	Murphy Creek	10/17/2017	15	394.22
KUKLA 34-34H	Murphy Creek	10/18/2017	0	381.09
KUKLA 34-34H	Murphy Creek	10/19/2017	24	371.55
KUKLA 34-34H	Murphy Creek	10/20/2017	19	363.22
KUKLA 34-34H	Murphy Creek	10/21/2017	24	360.83
KUKLA 34-34H	Murphy Creek	10/22/2017	12.00	170.54
	Average -9/23/2017 through 10/22/2017			408.47

KUKLA 34-34H

NSPS OOOOa Applicability Determination for Storage tanks

KUKLA 34-34H	Well name
408.4656931	Average of first thirty days of production after re-frack, bbl/d
8/29/2017	Date of first production after re-frack
3	Number of oil tanks
	Date of LACT unit installation
1	Decline factor
7.71	Storage tank emissions - total
43061-43066	Tank numbers
43066	LACT permissive tank

Completion Name	Field	Date	Down Time Hours	Actual Oil Production
Tat USA 34 Pad	Antelope	1/7/2018	0	7294.30
Tat USA 34 Pad	Antelope	1/8/2018	0	7609.21
Tat USA 34 Pad	Antelope	1/9/2018	0	8126.15
Tat USA 34 Pad	Antelope	1/10/2018	0	2545.17
Tat USA 34 Pad	Antelope	1/11/2018	0	5513.17
Tat USA 34 Pad	Antelope	1/12/2018	0	5476.94
Tat USA 34 Pad	Antelope	1/13/2018	0	4931.47
Tat USA 34 Pad	Antelope	1/14/2018	0	5253.53
Tat USA 34 Pad	Antelope	1/15/2018	0	6416.67
Tat USA 34 Pad	Antelope	1/16/2018	0	8174.47
Tat USA 34 Pad	Antelope	1/17/2018	0	8763.01
Tat USA 34 Pad	Antelope	1/18/2018	0	8968.40
Tat USA 34 Pad	Antelope	1/19/2018	0	10108.93
Tat USA 34 Pad	Antelope	1/20/2018	0	9813.21
Tat USA 34 Pad	Antelope	1/21/2018	0	9517.30
Tat USA 34 Pad	Antelope	1/22/2018	0	8865.20
Tat USA 34 Pad	Antelope	1/23/2018	0	8974.32
Tat USA 34 Pad	Antelope	1/24/2018	0	9093.51
Tat USA 34 Pad	Antelope	1/25/2018	0	7749.78
Tat USA 34 Pad	Antelope	1/26/2018	0	6678.20
Tat USA 34 Pad	Antelope	1/27/2018	0	6246.89
Tat USA 34 Pad	Antelope	1/28/2018	0	6489.15
Tat USA 34 Pad	Antelope	1/29/2018	0	6430.02
Tat USA 34 Pad	Antelope	1/30/2018	0	4966.54
Tat USA 34 Pad	Antelope	1/31/2018	0	3788.29
Tat USA 34 Pad	Antelope	2/1/2018	0	3666.55
Tat USA 34 Pad	Antelope	2/2/2018	0	3976.75
Tat USA 34 Pad	Antelope	2/3/2018	0	3474.36
Tat USA 34 Pad	Antelope	2/4/2018	0	3576.47
Tat USA 34 Pad	Antelope	2/5/2018	0	3164.43
	Average 1/9/2018 through 2/7/2018			6521.75

LOCKWOOD USA 44-22TFH, TAT USA 34-22H, FORSMAN USA 44-22H, MURPHY USA 34-22TFH-2B, BEGOLA USA 34-22H

NSPS OOOOa Applicability Determination for Storage tanks

Tat USA 34 Pad	Facility Name
6521.75	Average of first thirty days of production after re-frack, bbl/d
1/7/2018	Date of first production after re-frack
14	Number of oil tanks
	Date of LACT unit installation
0.5	Decline factor
52.83	Storage tank emissions - total
2807-2820	Tank numbers
2814, 2820	LACT permissive tank

Completion Name	Field	Date	Down Time Hours	Actual Oil Production
Moline Pad	Big Bend, Van Hook	8/9/2017	0.00	3417.04235
Moline Pad	Big Bend, Van Hook	8/10/2017	0.00	3745.325723
Moline Pad	Big Bend, Van Hook	8/11/2017	0.00	3392.965457
Moline Pad	Big Bend, Van Hook	8/12/2017	0.00	3249.993868
Moline Pad	Big Bend, Van Hook	8/13/2017	0.00	3103.622113
Moline Pad	Big Bend, Van Hook	8/14/2017	0.00	3210.933931
Moline Pad	Big Bend, Van Hook	8/15/2017	0.00	2773.179883
Moline Pad	Big Bend, Van Hook	8/16/2017	0.00	2919.943819
Moline Pad	Big Bend, Van Hook	8/17/2017	0.00	2878.957975
Moline Pad	Big Bend, Van Hook	8/18/2017	0.00	2845.613784
Moline Pad	Big Bend, Van Hook	8/19/2017	0.00	3082.71441
Moline Pad	Big Bend, Van Hook	8/20/2017	0.00	2652.797448
Moline Pad	Big Bend, Van Hook	8/21/2017	0.00	2820.267173
Moline Pad	Big Bend, Van Hook	8/22/2017	0.00	2381.442351
Moline Pad	Big Bend, Van Hook	8/23/2017	0.00	2395.885721
Moline Pad	Big Bend, Van Hook	8/24/2017	0.00	2566.079267
Moline Pad	Big Bend, Van Hook	8/25/2017	0.00	2176.561645
Moline Pad	Big Bend, Van Hook	8/26/2017	0.00	1081.683535
Moline Pad	Big Bend, Van Hook	8/27/2017	0.00	1259.256965
Moline Pad	Big Bend, Van Hook	8/28/2017	0.00	1152.717258
Moline Pad	Big Bend, Van Hook	8/29/2017	0.00	661.5746259
Moline Pad	Big Bend, Van Hook	8/30/2017	0.00	166.6666667
Moline Pad	Big Bend, Van Hook	8/31/2017	0.00	1000.732391
Moline Pad	Big Bend, Van Hook	9/1/2017	0.00	1176.540038
Moline Pad	Big Bend, Van Hook	9/2/2017	0.00	1235.712234
Moline Pad	Big Bend, Van Hook	9/3/2017	0.00	1367.017352
Moline Pad	Big Bend, Van Hook	9/4/2017	0.00	2051.201123
Moline Pad	Big Bend, Van Hook	9/5/2017	0.00	2725.296445
Moline Pad	Big Bend, Van Hook	9/6/2017	0.00	2809.133172
Moline Pad	Big Bend, Van Hook	9/7/2017	0.00	2772.026905
	Average - 8/9/2017 through 9/7/2017			2302.429521

MOLINE 14-32H, LACEY USA 11-5H

NSPS OOOOa Applicability Determination for Storage tanks

Moline Pad	Facility name
2302.429521	Average of first thirty days of production
8/9/2017	Date of first production
10	Number of oil tanks
7/25/2017	Date of LACT unit installation
0.5	Decline factor
20.67	Storage tank emissions - total
2796-2805	Tank numbers
2799, 2800, 2804, 2805	LACT permissive tank

Appendix F– Storage Tank Requirements Deviations

Facility	Inspection Date	Issue	Repair	Repair Date
Clarks Creek USA CTB	12/17/2017	leak on Water Tank #1	Water Tank #1 Thief Hatch Cleaned	12/17/2017
Golberg USA CTB	3/9/2018	leak on Water Tank #3	Water Tank #3 leak fixed	3/9/2018
Raymond USA CTB	5/16/2018	Hatches leaking.	Gasket cleaned.	5/16/2018
Mikkelsen USA CTB	5/29/2018	Hatches leaking.	Flame Arrestor replaced	5/29/2018
Eagle USA 41-15H	8/1/2018	Tank 2313 thief hatch leaking	Tank 2313 thief hatch stuck. Hatch was reset and cleaned	8/1/2018
Marlin 14 CTB	2/21/2018	Thief Hatch Leak	leak fixed	4/11/2018
Voight 11-15H	3/26/2818	Leak on load out of tank # 41289	leak fixed	5/31/2018
Mary Hansen 14-9H	4/22/2018	Production Line to back of tank leaking	leak fixed	5/29/2018
Mary Hansen 14-9H	4/22/2018	Vent line leaking at threads	leak fixed	5/29/2018
Mary Hansen 14-9H	5/14/2018	Vent Line Leak at tank	leak fixed	5/29/2018
Mary Hansen 14-9H	5/14/2018	Production line leaking at tank drain	leak fixed	5/29/2018
William Kukla CTB	7/13/2018	Leaking thief hatch on tank #43066	Thief Hatch Internals replaced, Flame arrestor replaced.	8/24/2018

Appendix G – Fugitive Emissions Components Monitoring Surveys

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
2017083046990.0	Oscar Stohler Pad	8/30/2017	12:30:00	13:04:00	79	Sunny	15	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No		0		
2017090136207.0	Trotter Pad	9/1/2017	09:03:00	10:05:00	71	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2017090841713.0	Beck Pad	9/8/2017	10:35:00	11:36:00	64	Sunny	5	FLIR / BK 2 - 4440657		[redacted]	No		0		
201709111.0	Moline-Lacey Pad	9/6/2017	11:30:00	12:30:00	65	Sunny	11.5	FLIR / BK 1 - 44402088		[redacted]	No		0		
2017100210.0	William Kukla Pad	10/2/2017	13:00:00	13:30:00	52	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
201710033.0	Delia USA pad	10/2/2017	11:33:00	12:35:00	51	Partly Cloudy	9	FLIR / BK 2 - 4440657		[redacted]	No		0		
2017100922.0	Charchenko 14 Pad	10/9/2017	15:18:00	15:18:00	51	Sunny	15	FLIR / BK 2 - 4440657		[redacted]	No		0		
201711066.0	Appledoorn 14 Pad	11/6/2017	12:45:00	12:59:00	20	Overcast	7	FLIR / BK 1 - 4402088		[redacted]	No		0		
201711068.0	Christensen Pad	11/6/2017	13:10:00	13:24:00	22	Overcast	7	FLIR / BK 1 - 4402088		[redacted]	No		0		
201711075.0	Tescher 11-27H	11/7/2017	11:30:00	12:06:00	23	Sunny	10	FLIR / BK 2 - 4440657		[redacted]	No		0		
2017110833.0	Goldberg USA Pad	10/31/2017	10:00:00	10:45:00	28	Sunny	9.2	FLIR / BK 1 - 4402088		[redacted]	No		0		
2017110834.0	Raymond USA Pad	10/31/2017	10:30:00	10:46:00	28	Sunny	9.2	FLIR / BK 1 - 4402088		[redacted]	No		0		
2017120114.0	Trotter Pad	12/1/2017	12:40:00	12:51:00	46	Partly Cloudy	15	FLIR / BK 2 - 4440657		[redacted]	No		0		
201801141.0	Stark Pad	11/2/2017	09:00:00	10:00:00	26	Overcast	16	FLIR / BK 1 - 4402088		[redacted]	No		0		
201801142.0	Mikkelsen 11-14H	11/2/2017	10:02:00	16:03:00	26	Overcast	16	FLIR / BK 1 - 4402088		[redacted]	No		0		
201801145.0	Grady USA	11/2/2017	16:39:00	16:40:00	28	Overcast	16	FLIR / BK 1 - 4402088		[redacted]	No		0		
2018011910.0	Chapman	1/19/2018	13:07:00	15:12:00	41	Overcast	11	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020712.0	Pelton Pad	2/7/2018	09:20:00	09:50:00	-3	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020716.0	Felix USA Pad	2/7/2018	11:10:00	11:30:00	1	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020717.0	Ringer Pad	2/7/2018	12:00:00	12:20:00	5	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020724.0	O'Neil 34 Pad	2/7/2018	13:00:00	13:20:00	8	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020726.0	O'Neil 24 Pad	2/7/2018	13:20:00	14:38:00	9	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018020728.0	Veronica USA	1/25/2018	10:30:00	12:30:00	28	Overcast	9	FLIR / BK 2 - 4440657		[redacted]	No		0		

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
2018020913.0	Quill Pad	2/9/2018	10:40:00	10:55:00	-3	Sunny	5	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No		0		
2018021315.0	Trotter Pad	2/13/2018	11:10:00	11:30:00	16	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018021317.0	Oscar Stohler Pad	2/13/2018	11:30:00	11:49:00	21	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No		0		
201802218.0	TAT USA 34 Pad	2/21/2018	10:30:00	11:00:00	4	Sunny	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018030830.0	Fred Hansen Pad	3/8/2018	21:46:00	22:47:00	9	Sunny	3	FLIR / BK 2 - 4440657		[redacted]	No		0		
201804099.0	Kukla 34 Pad	4/9/2018	00:30:00	13:00:00	28	Overcast	9	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018041125.0	Tescher 11-27H Pad	4/11/2018	10:30:00	23:00:00	37	Overcast	14	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018041214.0	Martinez USA 24-8H	4/12/2018	08:00:00	09:21:00	31	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
201804186.1	Goldberg USA Pad	4/18/2018	10:15:00	10:55:00	37	Overcast	2	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018052511.0	Moline-Lacey Pad	5/25/2018	10:00:00	10:20:00	80.5	Sunny	19.2	FLIR / Insight - 44401177		[redacted]	No		0		
2018052913.0	O'Neil 24 Pad	5/29/2018	09:00:00	09:20:00	68	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018052915.0	O'Neil 34 Pad	5/29/2018	09:25:00	09:41:00	68	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018052919.0	Stohler 41 Pad	5/29/2018	10:45:00	11:10:00	69	Overcast	3	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018052921.0	Trotter Pad	5/29/2018	11:30:00	11:45:00	72	Overcast	3	FLIR / BK 2 - 4440657		[redacted]	No		0		
201805301.0	Pelton Pad	5/30/2018	07:20:00	07:39:00	63	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018053118.0	Appledoorn 14 Pad	5/31/2018	09:45:00	09:55:00	74	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018053135.0	Mary Hansen Pad	5/31/2018	14:00:00	14:09:00	65	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018053138.0	Repp Trust Pad	5/31/2018	14:30:00	14:43:00	67	Overcast	10	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018060119.0	Kempf Trust Pad	6/1/2018	10:15:00	10:30:00	69	Partly Cloudy	13	FLIR / BK 2 - 4440657		[redacted]	No		0		
201806018.0	Repp Pad	6/1/2018	07:40:00	07:55:00	63	Partly Cloudy	13	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018060414.0	LaDonna Klatt Pad	6/4/2018	11:40:00	11:54:00	80	Sunny	8	FLIR / BK 2 - 4440657		[redacted]	No		0		
2018060423.0	Ringer Pad	6/4/2018	13:00:00	13:22:00	84	Partly Cloudy		FLIR / BK 2 - 4440657		[redacted]	No		0		
2018060522.0	Beck Pad	6/5/2018	11:40:00	11:45:00	75	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No		0		

Quad Oa Audit Summary

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201806124.0	Chapman	6/12/2018	08:15:00	08:40:00	59	Sunny	16	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No		0		
201807307.0	Oscar Stohler Pad	7/30/2018	22:50:00	11:11:00	78	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
201807309.0	Stohler 41 Pad	7/30/2018	11:00:00	12:08:00	80	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No		0		
2017083138848.0	Charchenko 14 Pad	8/31/2017	10:35:00	10:51:00	72	Overcast	4	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	9/26/2017	
201709112.0	Kermit USA	9/6/2017	14:30:00	16:00:00	73	Sunny	11.5	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	9/11/2017	FLIR / Bakken 1 - 44402088
201709112.0	Kermit USA	9/6/2017	14:30:00	16:00:00	73	Sunny	11.5	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	9/11/2017	FLIR / Bakken 1 - 44402088
2017101015.0	Wm & Agnes Scott Pad	10/10/2017	09:15:00	09:33:00	40	Sunny	10	FLIR / BK 2 - 4440657		[redacted]	No	Open-Ended Lines	1	11/30/2017	
2017101015.0	Wm & Agnes Scott Pad	10/10/2017	09:15:00	09:33:00	40	Sunny	10	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	12/12/2017	FLIR / Bakken 2 - 44400657
2017101610.0	Pearl Pad	11/2/2017	11:05:00	22:30:00	41	Sunny	6.9	FLIR / BK 1 - 4402088		[redacted]	No	Flanges	1	1/19/2018	
201711069.0	Voigt Pad	11/6/2017	14:05:00	15:24:00	20	Overcast	10	FLIR / BK 1 - 4402088		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/19/2018	
201711069.0	Voigt Pad	11/6/2017	14:05:00	15:24:00	20	Overcast	10	FLIR / BK 1 - 4402088		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/19/2018	
201711074.0	Kempf Trust Pad	11/7/2017	11:00:00	11:25:00	20	Sunny	10	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/18/2018	

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
201711074.0	Kempf Trust Pad	11/7/2017	11:00:00	11:25:00	20	Sunny	10	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/18/2018	
2017112718.0	Chapman	11/27/2017	12:30:00	12:49:00	54	Overcast	15	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/19/2018	FLIR / Bakken 2 - 44400657
201801144.0	Bingo Pad	11/2/2017	16:19:00	16:23:00	26	Partly Cloudy	16	FLIR / BK 1 - 4402088		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/14/2018	
201801144.0	Bingo Pad	11/2/2017	16:19:00	16:23:00	26	Partly Cloudy	16	FLIR / BK 1 - 4402088		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/14/2018	
201801146.0	Clarks Creek USA Pad	11/2/2017	16:48:00	16:52:00	28	Overcast	16	FLIR / BK 1 - 4402088		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	1/14/2018	
201801147.0	Kermit USA	11/2/2017	16:57:00	17:00:00	28	Overcast	16	FLIR / BK 1 - 4402088		[redacted]	No		0	1/14/2018	
2018012611.0	TAT USA 34 Pad	1/25/2018	08:30:00	22:30:00	28	Overcast	9	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	2/21/2018	FLIR / Bakken 2 - 44400657
2018012611.0	TAT USA 34 Pad	1/25/2018	08:30:00	22:30:00	28	Overcast	9	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	2/21/2018	
201802079.0	Larry Repp 31 Pad	2/7/2018	08:45:00	09:10:00	-5	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	
201802079.0	Larry Repp 31 Pad	2/7/2018	08:45:00	09:10:00	-5	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
201802079.0	Larry Repp 31 Pad	2/7/2018	08:45:00	09:10:00	-5	Overcast	7	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	2/22/2018	
2018020713.0	Evelyn	2/7/2018	10:00:00	10:32:00	-1	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/7/2018	
2018020713.0	Evelyn	2/7/2018	10:00:00	10:32:00	-1	Overcast	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/7/2018	
2018020910.0	Mary Hansen Pad	2/9/2018	10:20:00	10:45:00	-6	Sunny	5	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/7/2018	FLIR / Bakken 2 - 44400657
2018021310.0	Repp Trust Pad	2/13/2018	10:00:00	10:32:00	13	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	8/10/2018	FLIR / Bakken 1 - 44402088
2018021310.0	Repp Trust Pad	2/13/2018	10:00:00	10:32:00	13	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	
2018021313.0	Repp Pad	2/13/2018	10:30:00	10:55:00	16	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/6/2018	
2018021313.0	Repp Pad	2/13/2018	10:30:00	10:55:00	16	Sunny	18	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/6/2018	
201802237.0	Marlin 14 Pad	2/23/2018	11:30:00	12:24:00	14	Sunny	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	4/11/2018	FLIR / Bakken 2 - 44400657
201802237.0	Marlin 14 Pad	2/23/2018	11:30:00	12:24:00	14	Sunny	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	4/11/2018	FLIR / Bakken 2 - 44400657

Quad Oa Audit Summary

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2018030113.0	Marlin 44 Pad	3/1/2018	11:48:00	12:50:00	31	Sunny	8	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Connectors	1	3/1/2018	
2018031216.0	Bethol CTB	3/8/2018	20:45:00	22:00:00	14	Sunny	3	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/12/2018	
2018031217.0	Beck Pad	3/12/2018	23:30:00	14:00:00	32	Sunny	4	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/12/2018	
2018031217.0	Beck Pad	3/12/2018	23:30:00	14:00:00	32	Sunny	4	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	3/12/2018	
2018040339.0	Delia USA pad	4/3/2018	23:30:00	12:40:00	20	Overcast	9	FLIR / BK 1 - 4402088		[redacted]	No	Pressure Relief Devices	1	4/10/2018	FLIR / Bakken 2 - 44400657
2018040640.0	Charchenko 14 Pad	4/6/2018	12:15:00	13:00:00	14	Sunny	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	4/10/2018	FLIR / Bakken 2 - 44400657
2018040910.0	Wm & Agnes Scott Pad	4/9/2018	13:15:00	14:15:00	28	Overcast	9	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	
2018051624.0	Goldberg USA Pad	5/16/2018	09:02:00	12:00:00	76	Sunny	6.2	FLIR / Insight - 44401177		[redacted]	No		0	5/16/2018	
2018051624.0	Goldberg USA Pad	5/16/2018	09:02:00	12:00:00	76	Sunny	6.2	FLIR / Insight - 44401177		[redacted]	No		0	5/22/2018	
2018051624.0	Goldberg USA Pad	5/16/2018	09:02:00	12:00:00	76	Sunny	6.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/16/2018	
2018051624.0	Goldberg USA Pad	5/16/2018	09:02:00	12:00:00	76	Sunny	6.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	

Quad Oa Audit Summary

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2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No		0	5/26/2018	
2018052510.0	Raymond USA Pad	5/25/2018	08:55:00	09:50:00	77	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No		0	6/13/2018	
2018052512.0	Stark Pad	5/25/2018	10:35:00	11:05:00	80.9	Sunny	18.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052512.0	Stark Pad	5/25/2018	10:35:00	11:05:00	80.9	Sunny	18.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018052512.0	Stark Pad	5/25/2018	10:35:00	11:05:00	80.9	Sunny	18.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052512.0	Stark Pad	5/25/2018	10:35:00	11:05:00	80.9	Sunny	18.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018052513.0	Pearl Pad	5/25/2018	12:00:00	12:30:00	83	Sunny	14	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	

Quad Oa Audit Summary

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2018052513.0	Pearl Pad	5/25/2018	12:00:00	12:30:00	83	Sunny	14	FLIR / Insight - 44401177		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052513.0	Pearl Pad	5/25/2018	12:00:00	12:30:00	83	Sunny	14	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052513.0	Pearl Pad	5/25/2018	12:00:00	12:30:00	83	Sunny	14	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052514.2	Clarks Creek USA Pad	5/25/2018	13:00:00	13:25:00	83.3	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052514.2	Clarks Creek USA Pad	5/25/2018	13:00:00	13:25:00	83.3	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
201805259.1	Grady USA	5/25/2018	12:35:00	12:00:00	84.5	Sunny	12.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
201805259.1	Grady USA	5/25/2018	12:35:00	12:00:00	84.5	Sunny	12.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
201805259.1	Grady USA	5/25/2018	12:35:00	12:00:00	84.5	Sunny	12.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
201805259.1	Grady USA	5/25/2018	12:35:00	12:00:00	84.5	Sunny	12.7	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	

Quad Oa Audit Summary

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2018052515.0	Mikkelsen 11-14H	5/25/2018	11:15:00	11:55:00	82.4	Sunny	15.2	FLIR / Insight - 44401177		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052515.0	Mikkelsen 11-14H	5/25/2018	11:15:00	11:55:00	82.4	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052515.0	Mikkelsen 11-14H	5/25/2018	11:15:00	11:55:00	82.4	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No		0	5/26/2018	
2018052516.0	Kermit USA	5/25/2018	14:10:00	14:45:00	87.5	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052516.0	Kermit USA	5/25/2018	14:10:00	14:45:00	87.5	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/27/2018	
2018052516.0	Kermit USA	5/25/2018	14:10:00	14:45:00	87.5	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No		0	5/26/2018	
2018052516.0	Kermit USA	5/25/2018	14:10:00	14:45:00	87.5	Sunny	15.2	FLIR / Insight - 44401177		[redacted]	No		0	6/27/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No		0	5/26/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No		0	6/22/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Valves	1	5/26/2018	
2018052517.0	Veronica USA	5/25/2018	15:00:00	15:50:00	86.6	Sunny	11.8	FLIR / Insight - 44401177		[redacted]	No	Valves	1	6/22/2018	
2018052518.0	TAT USA 34 Pad	5/25/2018	15:35:00	12:40:00	88.3	Sunny	14.3	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	

Quad Oa Audit Summary

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2018052518.0	TAT USA 34 Pad	5/25/2018	15:35:00	12:40:00	88.3	Sunny	14.3	FLIR / Insight - 44401177		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052518.0	TAT USA 34 Pad	5/25/2018	15:35:00	12:40:00	88.3	Sunny	14.3	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052518.0	TAT USA 34 Pad	5/25/2018	15:35:00	12:40:00	88.3	Sunny	14.3	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/22/2018	
2018052519.0	Eagle USA Pad	5/25/2018	17:05:00	17:25:00	86.2	Sunny	10.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052519.0	Eagle USA Pad	5/25/2018	17:05:00	17:25:00	86.2	Sunny	10.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/27/2018	
2018052519.0	Eagle USA Pad	5/25/2018	17:05:00	17:25:00	86.2	Sunny	10.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/26/2018	
2018052519.0	Eagle USA Pad	5/25/2018	17:05:00	17:25:00	86.2	Sunny	10.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/27/2018	
2018052917.0	Oscar Stohler Pad	5/29/2018	10:10:00	10:27:00	68	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018052917.0	Oscar Stohler Pad	5/29/2018	10:10:00	10:27:00	68	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/29/2018	

Quad Oa Audit Summary

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2018053039.0	Voigt Pad	5/30/2018	11:00:00	11:24:00	70	Partly Cloudy	8	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/30/2018	
2018053039.0	Voigt Pad	5/30/2018	11:00:00	11:24:00	70	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	
2018053054.0	Bethol CTB	5/30/2018	14:20:00	14:06:00	75	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/31/2018	
2018053054.0	Bethol CTB	5/30/2018	14:20:00	14:06:00	75	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018053054.0	Bethol CTB	5/30/2018	14:20:00	14:06:00	75	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/5/2018	
2018053054.0	Bethol CTB	5/30/2018	14:20:00	14:06:00	75	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018053060.0	Chapman	5/30/2018	09:40:00	22:44:00	63	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/30/2018	
2018053060.0	Chapman	5/30/2018	09:40:00	22:44:00	63	Partly Cloudy	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/13/2018	
2018053136.0	Larry Repp 31 Pad	5/31/2018	14:20:00	14:30:00	67	Overcast	10	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/31/2018	

Quad Oa Audit Summary

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2018053136.0	Larry Repp 31 Pad	5/31/2018	14:20:00	14:30:00	67	Overcast	10	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	8/24/2018	FLIR / Bakken 1 - 44402088
2018053140.0	Quill Pad	5/31/2018	14:47:00	15:05:00	67	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/31/2018	
2018053140.0	Quill Pad	5/31/2018	14:47:00	15:05:00	67	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	
2018053140.0	Quill Pad	5/31/2018	14:47:00	15:05:00	67	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	5/31/2018	
2018053140.0	Quill Pad	5/31/2018	14:47:00	15:05:00	67	Overcast	8	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/30/2018	FLIR / Bakken 2 - 44400657
201806019.0	Christensen Pad	6/1/2018	07:55:00	08:14:00	64	Partly Cloudy	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/1/2018	
201806019.0	Christensen Pad	6/1/2018	07:55:00	08:14:00	64	Partly Cloudy	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/6/2018	FLIR / Bakken 2 - 44400657
2018060111.0	Darcy / Evelyn-Patrick Pad	6/1/2018	08:20:00	08:47:00	64	Overcast	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/1/2018	
2018060111.0	Darcy / Evelyn-Patrick Pad	6/1/2018	08:20:00	08:47:00	64	Overcast	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/6/2018	FLIR / Bakken 2 - 44400657

Quad Oa Audit Summary

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2018060111.0	Darcy / Evelyn-Patrick Pad	6/1/2018	08:20:00	08:47:00	64	Overcast	11	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/1/2018	
2018060111.0	Darcy / Evelyn-Patrick Pad	6/1/2018	08:20:00	08:47:00	64	Overcast	11	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/10/2018	FLIR / Bakken 2 - 44400657
2018060515.0	Marlin 14 Pad	6/5/2018	09:50:00	10:23:00	72	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/6/2018	
2018060515.0	Marlin 14 Pad	6/5/2018	09:50:00	10:23:00	72	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018060515.0	Marlin 14 Pad	6/5/2018	09:50:00	10:23:00	72	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/6/2018	
2018060515.0	Marlin 14 Pad	6/5/2018	09:50:00	10:23:00	72	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018060523.0	Delia USA pad	6/5/2018	12:00:00	12:37:00	75	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/6/2018	
2018060523.0	Delia USA pad	6/5/2018	12:00:00	12:37:00	75	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018060523.0	Delia USA pad	6/5/2018	12:00:00	12:37:00	75	Partly Cloudy	7	FLIR / BK 2 - 4440657		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/6/2018	

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
2018060523.0	Delia USA pad	6/5/2018	12:00:00	12:37:00	75	Partly Cloudy	7	FLIR / BK 2 - 4440657		(b) (6) [redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/15/2018	FLIR / Bakken 2 - 44400657
2018062820.0	Myrmidon-Hunts Along Pad	6/28/2018	11:47:00	12:57:00	82.1	Partly Cloudy	6.4	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/28/2018	
201807028.0	Sherman Pad	6/28/2018	10:06:00	10:30:00	81.7	Partly Cloudy	7.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	6/28/2018	
201807028.0	Sherman Pad	6/28/2018	10:06:00	10:30:00	81.7	Partly Cloudy	7.8	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/31/2018	
201807028.0	Sherman Pad	6/28/2018	10:06:00	10:30:00	81.7	Partly Cloudy	7.8	FLIR / Insight - 44401177		[redacted]	No		0	6/28/2018	
201807028.0	Sherman Pad	6/28/2018	10:06:00	10:30:00	81.7	Partly Cloudy	7.8	FLIR / Insight - 44401177		[redacted]	No		0	7/31/2018	
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/31/2018	
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/31/2018	
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/31/2018	
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		[redacted]	No	Thief hatches or other openings on a controlled storage vessel	1	7/31/2018	
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		[redacted]	No		0	7/31/2018	

Quad Oa Audit Summary

Facility Record No	Identification of Each Affected Facility	Date of Survey	Survey Begin Time	Survey End Time	Ambient Temperature During Survey	Sky Conditions During Survey	Maximum Wind Speed During Survey	Monitoring Instrument Used	2nd Monitoring Instrument Used	Name of Surveyor	Deviations From Monitoring Plan If none State none	Type of Component for which Fugitive Emissions Detected	Number of Each Component for Which Fugitive Emissions Detected	Date of Successful Repair of Fugitive Emissions Component	Type of Instrument Used to Resurvey Components Not Repaired During Original Survey
2018073122.0	Bear Den Pad	7/31/2018	08:34:00	11:10:00	73	Sunny	14.9	FLIR / Insight - 44401177		(b) (6) [redacted]	No		0	7/31/2018	

Appendix H- Certification signed by the qualified professional engineer for each closed vent system routing to a control device.

Appendix H- Certification signed by the qualified professional engineer for each closed vent system routing to a control device.

Beard Den Pad

HALKER
CONSULTING

7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

Bear Den Facility Tank Battery Vent Line Design & Capacity Assessment

(b) (6) [redacted]

TO:	Marathon Oil
FROM:	Tim Archuleta
CC:	Nate Mascarenas, Kendra Meeker
DATE:	June 29, 2017
RE:	Bear Den Facility- Vent Line Design and Capacity Assessment

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Bear Den Facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.5 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.4 psig (6.1 oz/in^{2}g).

During normal operating conditions, 6.1 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 40% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.9 oz/in^2 and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 241 mscfd (771 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to 380 MSCFD (1216 lb/hr) and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.57 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

		Hydraulic Calculations												
Client:	Marathon Oil	Basis / Notes -->												
Project:	TVCS Vent line													
Location:	Bear Den Facility													
Unit:														
Proj #:	16030-16	Atm Pres 13.5	atm flare tip	After KO	Outlet of KO	KO	Before KO Drum	all tanks	3 tanks	2 tanks	1 tank			
By/Chk'd:		Pres Unit psia												
Rev/Date:	28-Jun-17	SEGMENT ID:	G	H	I	J	K	L	M	N	O			
Pressure Data	Upstream Segment ID or known press.	psia												
	Downstream Segment ID or known press.	psia	13.50	G	H	I	J	K	L	M	N			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	d			
Fric Method (1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=Isothermal)														
Holdup Meth (blank=default, 2=Hughmark, 3=L-M, 4=B&B, 5=Eaton)														
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	inches	4.000	4.000	6.000	36.000	6.000	4.000	4.000	4.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	std			
	Straight pipe length	ft	1.0	84.0	1.0	8.0	1.0	358.5	15.0	15.0	15.0			
Elevation	Inlet & Outlet OR	Inlet ft												
		Outlet ft												
	Difference (Outlet - Inlet)	Difference ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
3K Method	90's	Std (R/D=1), threaded												
		Short Radius (R/D=1), flgd/welded												
	90's	Standard (R/D=1.5), all types		2	1			4						
	Mitered	1 weld (90 deg angle)												
		2 weld (45 deg angle)												
		3 weld (30 deg angle)												
	Choose type	Plug Valve Branch Flow												
	Choose type	Plug Valve Straight Thru												
Elbows	45's	Short Radius (R/D=1), all types												
	45's	Standard (R/D=1.5), all types												
		Mitered, 1 weld, 45 deg angle												
		Mitered, 2 weld, 22.5 deg angle												
	Choose type	Ball Valve Full Port												
		Close Return (R/D=1), threaded												
	180's	Close Return (R/D=1), flgd/welded												
	180	Standard (R/D=1.5), all types												
Tees	Used as an Elbow	Standard (R/D=1), threaded												
		Long-radius (R/D=1.5), threaded												
		Standard (R/D=1), flanged or welded						3			1			
		Stub-in type branch												
	Flow-thru Tee	Threaded												
		Flanged or Welded			1			3	1	1				
		Stub-in type branch												
Valves	Gate, Ball or Plug	Full line size, Beta=1.0			1			2						
		Reduced trim, Beta=0.9												
		Reduced trim, Beta=0.8												
	Globe, standard													
	Globe - (Angle or Y-type) or Diaphragm (dam type)													
	Butterfly													
	Check	Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5												
		Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5						1						
		Tilting-disk												
Other DP	Pipe Entrance/Exit?(0=none,1=entr., 2=exit,3=both)				1		2				1			
	Swage to Diameter (at end)	in			4.000			6.000						
	Orifice Diameter	in												
	Initial Swage from Diameter	in												
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.050										
	Other Head Pressure Drop (Equip, etc.)	ft fluid												
	Valve Cv (Non-flashing liquid only!)	gpm/psi^.5												
	Miscellaneous Flow Resistance	K factor												
Liquid	Flow (provide mass OR volume basis)	lb/hr												
		gpm												
	Density	lb/ft3												
	Viscosity	cP												
	Surface Tension (2 phase only)	dyne/cm												
Vapor	Flow Rate	lb/hr	771.26	771.26	771.26	771.26	771.26	771.26	771.26	514.17	257.09			
	Density OR MW, Z & T	Density lb/ft3												
		MW	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14			
		Z	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994			
		Temp F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	4.026	6.065	35.250	6.065	4.026	4.026	4.026	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	771	771	771	771	771	771	771	514	257			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.05	0.11	0.11	0.11	0.25	0.39	0.39	0.40			
	Vapor Density (Avg)	lb/ft3	0.0642	0.0644	0.0647	0.0647	0.0647	0.0653	0.0660	0.0660	0.0661			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07			
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	6.7771	0.2006	0.0884	0.0884	0.0884	0.0884			
	Bulk Velocity	ft/sec	37.77	37.62	16.51	0.49	16.51	37.09	36.72	24.47	12.23			
	Erosional Velocity if solids present	ft/sec	394.79	394.02	393.25	393.23	393.21	391.24	389.25	389.14	389.09			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		1.18E+05	1.18E+05	7.86E+04	1.35E+04	7.86E+04	1.18E+05	1.18E+05	7.89E+04	3.95E+04			
	Friction Factor f (Colebrook & White)		0.0197	0.0197	0.0202	0.0296	0.0202	0.0197	0.0197	0.0208	0.0234			
Friction	K (straight pipe)		0.06	4.92	0.04	0.08	0.04	21.01	0.88	0.93	1.05			
	K (fittings + valves)		0.00	0.55	0.57	0.00	0.00	6.72	0.18	0.18	1.04			
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.02	0.31	0.00	0.00	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Total K		0.06	5.47	1.65	0.08	1.06	28.04	1.06	1.11	2.69			
	Velocity Head (Average Density Basis)	ft fluid	22.17	22.00	4.24	0.00	4.24	21.38	20.95	9.30	2.32			
	Equivalent length	ft	1.0	93.4	41.3	8.0	26.4	478.4	18.1	18.0	38.7			
TOTAL	Upstream Pressure before CV	psig	0.0006	0.1045	0.1077	0.1077	0.10969	0.382	0.392	0.397	0.400	<=	6.1	oz.in2
	Available Upstream Control Valve DP	psi												
	Segment Upstream pressure	psig	0.00	0.10	0.11	0.11	0.11	0.38	0.39	0.40	0.40			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.05	0.00	0.00	0.00	0.27	0.01	0.00	0.00			
	Acceleration Factor		1.46E-03	1.45E-03	2.80E-04	2.45E-07	2.80E-04	1.41E-03	1.36E-03	6.14E-04	1.53E-04			
	Total System Pressure Drop	psi	0.00	0.10	0.00	0.00	0.00	0.27	0.01	0.00	0.00			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.10	0.11	0.11	0.11	0.38	0.39	0.40			
	Available Downstream Control Valve DP	psi												
	Pressure after Control Valve	psig	0.0000	0.0006	0.1045	0.1077	0.1077	0.1097	0.3821	0.3923	0.3971			
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	OK			

Beck Pad CTB

HALKER CONSULTING

7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

BECK FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	John Van Pelt	
CC:	Tim Archuleta, Nate Mascarenas, Kendra Meeker	
DATE:	June 12, 2017	
RE:	BECK Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Beck facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.24 psig (3.9 oz/in^2g).

During normal operating conditions the 3.9 oz/in^2g pressure should be the highest pressure that the tanks will see and is 24% of the of 16 oz/in^2g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.72 oz/in^2 and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 213 mscfd (683 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to 436 MSCFD (1396 lb/hr) and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 2.04 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

Hydraulic Calculations

Client:	Marathon Oil	Basis /										
Project:	TVCS Vent Line	Notes -->	7	6	5	4	3	2	1	<= segment		
Location:	BECK Facility											
Unit:			4"	4"	6"		6"	4"	4"			
Proj #:	16039-11 Atm Pres	13.46	atm	After	Outlet	KO	Before	full flow	Half of			
By/Chk'd:	JVP Pres Unit	psia	flare tip	KO	of KO		KO Drum	to KO	tanks			
Rev/Date:	6-Jun-17	SEGMENT ID	G	H	I	J	K	L	M			
Pressure Data	Upstream Segment ID or known press.	psia										
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k	l			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d			
Fric Method	(1=Hazen g, 2 or blank=Dukler, 3=L-M, 4=Begg Brill, 5=Isothermal)											
Holdup Meth	(blank=default, 2=Hughmark, 3=L-M, 4=B&B, 5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	Inches	4.000	4.000	6.000	24.000	6.000	4.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std			
	Straight pipe length	ft		64.2	7.8	8.0	7.8	222.2	157.5			
Elevation	Inlet & Outlet — Inlet	ft										
	OR — Outlet	ft										
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
3K Method	90's — Std (R/D=1), threaded											
	Short Radius (R/D=1), flgd/welded											
	90's — Standard (R/D=1.5), all types			3					2			
	Mitered — 1 weld (90 deg angle)											
	Mitered — 2 weld (45 deg angle)											
	Mitered — 3 weld (30 deg angle)											
Elbows	Choose type — Plug Valve Branch Flow											
	Choose type — Plug Valve Straight Thru											
	45's — Short Radius (R/D=1), all types											
	45's — Standard (R/D=1.5), all types											
	Mitered, 1 weld, 45 deg angle											
	Mitered, 2 weld, 22.5 deg angle											
	Choose type — Ball Valve Full Port											
	180's — Close Return (R/D=1), threaded											
	180's — Close Return (R/D=1), flgd/welded											
	180 — Standard (R/D=1.5), all types											
Tees	Used as an Elbow — Standard (R/D=1), threaded											
	Long-radius (R/D=1.5), threaded											
	Standard (R/D=1), flanged or welded							2	2			
	Stub-in type branch											
	Flow-thru Tee — Threaded											
	Flanged or Welded			1				1	8			
	Stub-in type branch											
Valves	Gate, Ball or Plug — Full line size, Beta=1.0				1			1	1			
	Reduced trim, Beta=0.9											
	Reduced trim, Beta=0.8											
	Globe, standard											
	Globe - (Angle or Y-type) or Diaphragm (dam type)											
	Butterfly											
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5											
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1			
	Tilting-disk											
Other DP	Pipe Entrance/Exit? (0=none, 1=entr., 2=exit, 3=both)				1		2		1			
	Swage to Diameter (at end)	in			4.000			6.000				
	Orifice Diameter	in										
	Initial Swage from Diameter	in										
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.045								
	Other Head Pressure Drop (Equip, etc.)	ft fluid										
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5										
	Miscellaneous Flow Resistance	K factor										
Liquid	Flow (provide mass OR volume basis)	lb/hr										
		gpm										
	Density	lb/ft3										
	Viscosity	cP										
	Surface Tension (2 phase only)	dyne/cm										
Vapor	Flow Rate	lb/hr	682.78	682.78	682.78	682.78	682.78	682.78	341.39			
	Density OR MW, Z & T — Density	lb/ft3										
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14			
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994			
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	4.026	6.065	23.250	6.065	4.026	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	683	683	683	683	683	683	341			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.04	0.08	0.08	0.09	0.15	0.23			
	Vapor Density (Avg)	lb/ft3	0.0640	0.0642	0.0644	0.0644	0.0644	0.0647	0.0650			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.06	0.06	0.07			
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884			
	Bulk Velocity	ft/sec	33.54	33.43	14.69	1.00	14.68	33.17	16.49			
	Erosional Velocity if solids present	ft/sec	395.38	394.77	394.16	394.14	394.13	393.22	392.11			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		1.05E+05	1.05E+05	6.96E+04	1.82E+04	6.96E+04	1.05E+05	5.24E+04			
	Friction Factor f (Colebrook & White)		0.0200	0.0200	0.0206	0.0267	0.0206	0.0200	0.0222			
Friction	K (straight pipe)		0.00	3.82	0.32	0.11	0.32	13.23	10.43			
	K (fittings + valves)		0.00	1.01	0.15	0.00	0.00	2.39	5.97			
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.02	0.31	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Total K		0.00	4.83	1.51	0.11	1.33	15.93	17.01			
	Velocity Head (Average Density Basis)	ft fluid	17.48	17.37	3.35	0.02	3.35	17.10	4.23			
	Equivalent length	ft	0.0	81.1	36.8	8.0	32.6	267.5	256.8			
TOTAL	Upstream Pressure before CV	psig	0.0000	0.0822	0.0845	0.0845	0.08648	0.20898	0.242	<=	3.9	oz.in2
	Available Upstream Control Valve DP	psi										
	Segment Upstream pressure	psig	0.00	0.08	0.08	0.08	0.09	0.21	0.24			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.04	0.00	0.00	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.04	0.00	0.00	0.00	0.12	0.03			
	Acceleration Factor		1.15E-03	1.15E-03	2.21E-04	1.02E-06	2.21E-04	1.13E-03	2.79E-04			
	Total System Pressure Drop	psi	0.00	0.08	0.00	0.00	0.00	0.12	0.03			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.08	0.08	0.08	0.09	0.21			
	Available Downstream Control Valve DP	psi										
	Pressure after Control Valve	psig	0.0000	0.0000	0.0822	0.0845	0.0845	0.0855	0.2090			
	Error Status		OK	OK	OK	OK	OK	OK	OK			

Grady USA CTB

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303-515-2700

GRADY FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	Tim Archuleta	
CC:	Nate Mascarenas, Kendra Meeker	
DATE:	July 21, 2017	
RE:	Grady Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Grady facility tank battery vent line design to ensure that the thief hatches, which are set at 16 oz/in^2, will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the Marathon Oil verified tank orthos and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.36 psig (5.5 oz/in^2).

During normal operating conditions the 5.5 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 36% of the of 16 oz/in^{2}g set pressure of the thief hatch.

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Calculations:

A flare tip pressure drop of 0 oz/in² was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 1.1 oz/in² and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 278 Mscfd (890 lb/hr), and is based on a condensate flash factor provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 455 Mscfd and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in²). This is approximately 1.63 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations and the vent isometric drawing.*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not take into account the destructive efficiency of the controlled device or components upstream of the tank vent design.

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Attachment 1- Hydraulic Calculations

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Hydraulic Calculations

Client:	Marathon Oil	Basis / Notes -->	
Project:	TVCS Ventline		
Location:	Grady Facility		
Unit:			
Proj #:	16039-04	Atm Pres	13.46
By/Chk'd:	DJF	Pres Unit	psia
Rev/Date:	21-Jul-17		

			5	4	3	2	1	<= segment		
			4" atm flare tip	4" Outlet of KO	24" KO Drum	4" Upstream of KO	4" Hall of tanks			
	SEGMENT ID		G	H	I	J	K			
Pressure Data	Upstream Segment ID or known press.	psia								
	Downstream Segment ID or known press	psia	13.46	g	h	i	j			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d			
Fric Method	(1=Homog, 2=Lockhart-Martinelli, 3=L-M, 4=Beggs-Brill, 5=Isothermal)									
Holdup Meth	(blank=default, 2=Hughmark, 3=L-M, 4=B&B, 5=Eaton)									
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	inches	4.000	4.000	24.000	4.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std			
	Straight pipe length	ft	1.0	79.0	4.0	180.0	200.0			
Elevation	Inlet & Outlet — Inlet	ft								
	OR — Outlet	ft								
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0			
3K Method	90's — Std (R/D=1), threaded									
	90's — Short Radius (R/D=1), flgd/welded									
	90's — Standard (R/D=1.5), all types			2		2	2			
	Mitered — 1 weld (90 deg angle)									
	Mitered — 2 weld (45 deg angle)									
	Mitered — 3 weld (30 deg angle)									
Elbows	Choose type: Plug Valve Branch Flow									
	Choose type: Plug Valve Straight Thru									
	45's — Short Radius (R/D=1), all types									
	45's — Standard (R/D=1.5), all types									
	Mitered, 1 weld, 45 deg angle									
	Mitered, 2 weld, 22.5 deg angle									
	Choose type: Ball Valve Full Port									
	180's — Close Return (R/D=1), threaded									
	180's — Close Return (R/D=1), flgd/welded									
	180 — Standard (R/D=1.5), all types									
Tees	Used as an Elbow — Standard (R/D=1), threaded									
	Used as an Elbow — Long-radius (R/D=1.5), threaded									
	Used as an Elbow — Standard (R/D=1), flanged or welded						2			
	Used as an Elbow — Stub-in type branch									
	Flow-thru Tee — Threaded									
	Flow-thru Tee — Flanged or Welded						12			
	Flow-thru Tee — Stub-in type branch									
Valves	Gate, Ball or Plug — Full line size, Beta=1.0						1			
	Gate, Ball or Plug — Reduced trim, Beta=0.9									
	Gate, Ball or Plug — Reduced trim, Beta=0.8									
	Globe, standard									
	Globe - (Angle or Y-type) or Diaphragm (dam type)									
	Butterfly									
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5									
	Check — Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5									
	Check — Tilting-disk						1			
Other DP	Pipe Entrance/Exit? (0=none, 1=entr., 2=exit, 3=both)			1		2	1			
	Swage to Diameter (at end)	in								
	Orifice Diameter	in								
	Initial Swage from Diameter	in								
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.051						
	Other Head Pressure Drop (Equip, etc.)	ft fluid								
	Valve Cv (Non-flashing liquid only!)	gpm/psi^.5								
	Miscellaneous Flow Resistance	K factor								
Liquid	Flow (provide mass OR volume basis)	lb/hr								
		gpm								
	Density	lb/ft3								
	Viscosity	cP								
	Surface Tension (2 phase only)	dyne/cm								
Vapor	Flow Rate	lb/hr	889.66	889.66	889.66	889.66	444.83			
	Density OR MW, Z & T — Density	lb/ft3								
	MW		29.14	29.14	29.14	29.14	29.14			
	Z		0.994	0.994	0.994	0.994	0.994			
	Temp	F	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	4.026	23.250	4.026	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	890	890	890	890	445			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.06	0.13	0.20	0.31			
	Vapor Density (Avg)	lb/ft3	0.0640	0.0643	0.0646	0.0650	0.0655			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.07			
	Pipe Flow Area	ft2	0.0884	0.0884	2.9483	0.0884	0.0884			
	Bulk Velocity	ft/sec	43.89	43.48	1.30	43.04	21.35			
	Erosional Velocity if solids present	ft/sec	395.33	394.41	393.49	392.38	390.84			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		1.40E+05	1.40E+05	2.42E+04	1.40E+05	6.98E+04			
	Friction Factor f (Colebrook & White)		0.0193	0.0193	0.0249	0.0193	0.0212			
Friction	K (straight pipe)		0.06	4.54	0.05	10.34	12.64			
	K (fittings + valves)		0.00	0.55	0.00	0.55	5.62			
	K (entrance + exit + swages + orifice)		0.00	0.61	0.00	1.02	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00			
	Total K		0.06	5.69	0.05	11.90	18.87			
	Velocity Head (Average Density Basis)	ft fluid	29.66	29.39	0.03	28.79	7.08			
	Equivalent length	ft	1.0	99.1	4.0	207.2	298.6			
TOTAL	Upstream Pressure before CV	psig	0.0008	0.1265	0.12654	0.28138	0.34217	<=	5.47	oz.in2
	Available Upstream Control Valve DP	psi								
	Segment Upstream pressure	psig	0.00	0.13	0.13	0.28	0.34			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.05	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.07	0.00	0.15	0.06			
	Acceleration Factor		1.96E-03	1.94E-03	1.73E-06	1.90E-03	4.68E-04			
	Total System Pressure Drop	psi	0.00	0.13	0.00	0.15	0.06			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.13	0.13	0.28			
	Available Downstream Control Valve DP	psi								
	Pressure after Control Valve	psig	0.0000	0.0008	0.1265	0.1265	0.2814			
	Error Status		OK	OK	OK	OK	OK			
	V[Mscfd]		278	278	278	278	139			
	Vair [scfh]		11,611							

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Attachment 2- Tank Vent Orthos

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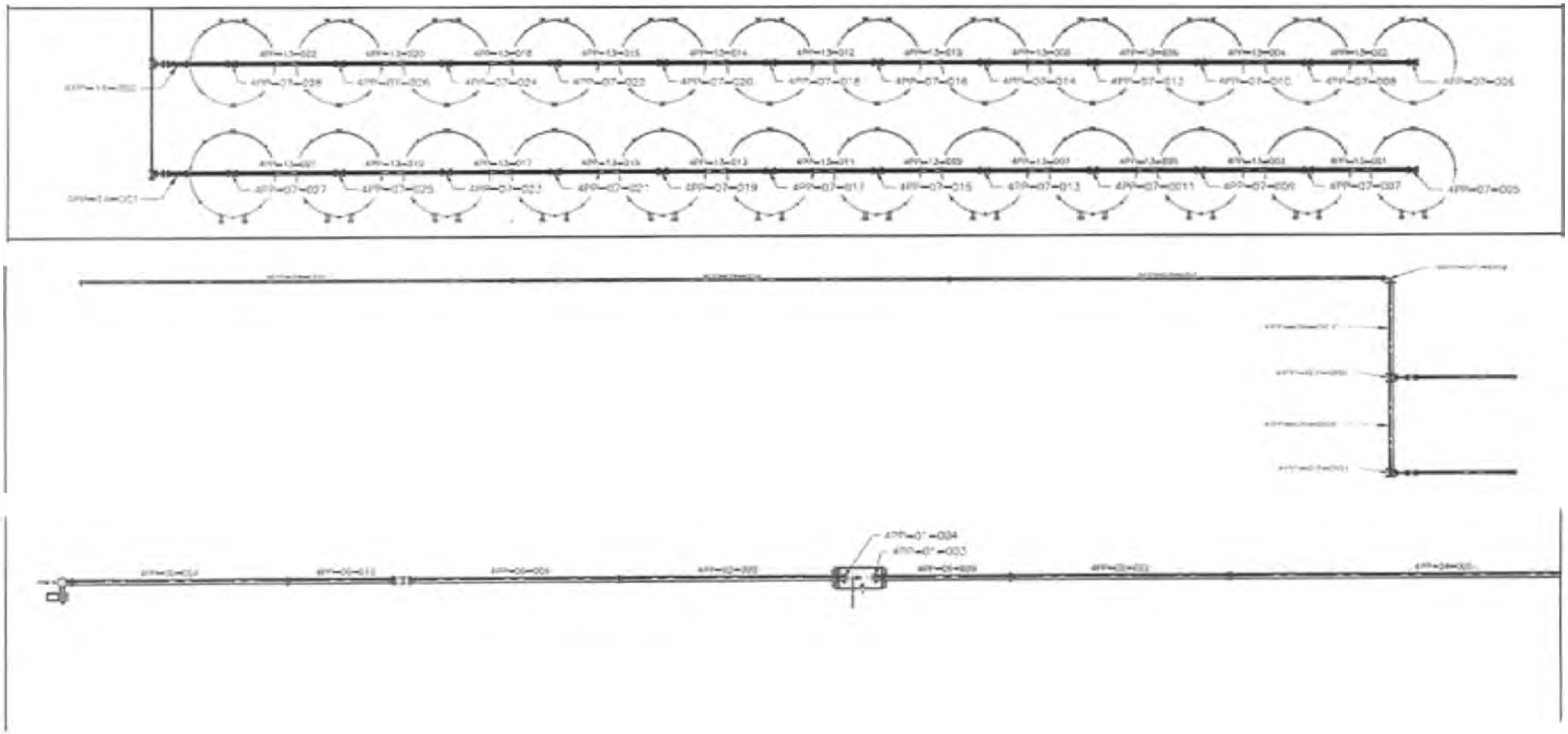

Hunts Along USA Pad

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Hunts Along Facility Tank Battery Vent Line Design & Capacity Assessment

TO:	Marathon Oil
FROM:	Tim Archuleta
CC:	Nate Mascarenas, Kendra Meeker
DATE:	July 19, 2017
RE:	Hunts Along Facility- Vent Line Design and Capacity Assessment

(b) (6) [redacted]

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Hunts Along Facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2, will not open during normal operating scenarios. The normal flow path for the vapor from the storage tanks will be to two flares where the off gas will be combusted to meet Quad Oa regulations.

This tank battery is comprised of three different production trains; Hunts Along, Shoots and Demaray with separate tank vent headers and flare knock out drums which then combine into a single flare header that flows to two flares.

Results:

Based on the 3D piping model (dated 7/19/17) of the vent systems and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the systems during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.5 psia. Pressure drop through the piping systems from the furthest storage tank to the flare was calculated for each of the three production trains. The maximum pressures of the tanks occur on different days of production and are:

Hunts Along:	5.1 oz/in^2g
Shoots:	8.7 oz/in^2g
Demaray:	7.7 oz/in^2g

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drops used is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

Because this tank vent system is composed of three individual trains each having their own peak rate, each train's peak rate, which occur on different days due to well staggering, were evaluated to determine the maximum pressure at the tanks for each train. It was determined that the maximum pressure for each train is attained at the peak flow rate for each train. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT on Hunts Along thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor. Shoots and Demaray do not have VRTs installed therefore no reduction in tank vapor rate was applied.

	Day 1: Shoots Peak Rate		Day 8: Demaray Peak Rate / System Peak Rate		Day 22: Hunts Along Peak Rate	
	CTB Flowrate [Mscfd]	CTB Tank Pressure [osig]	CTB Flowrate [Mscfd]	CTB Tank Pressure [osig]	CTB Flowrate [Mscfd]	CTB Tank Pressure [osig]
Hunts Along CTB	90	2.1	159	4.9	208	5.1
Shoots CTB	551	8.7	422	7.4	288	3.8
Demaray CTB	0	1.3	394	7.7	226	3.3
Total System	641	-	975	-	722	-

Using the same calculation methodology, the total gas flow rate can be increased to approximately 1,303 Mscfd and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.3 times the normal operating flow. The flow was increased by an equal factor of 13% applied to the maximum forecast tank vapor rates for each of the three trains.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1 - Normal Tank Vent Flow Rates

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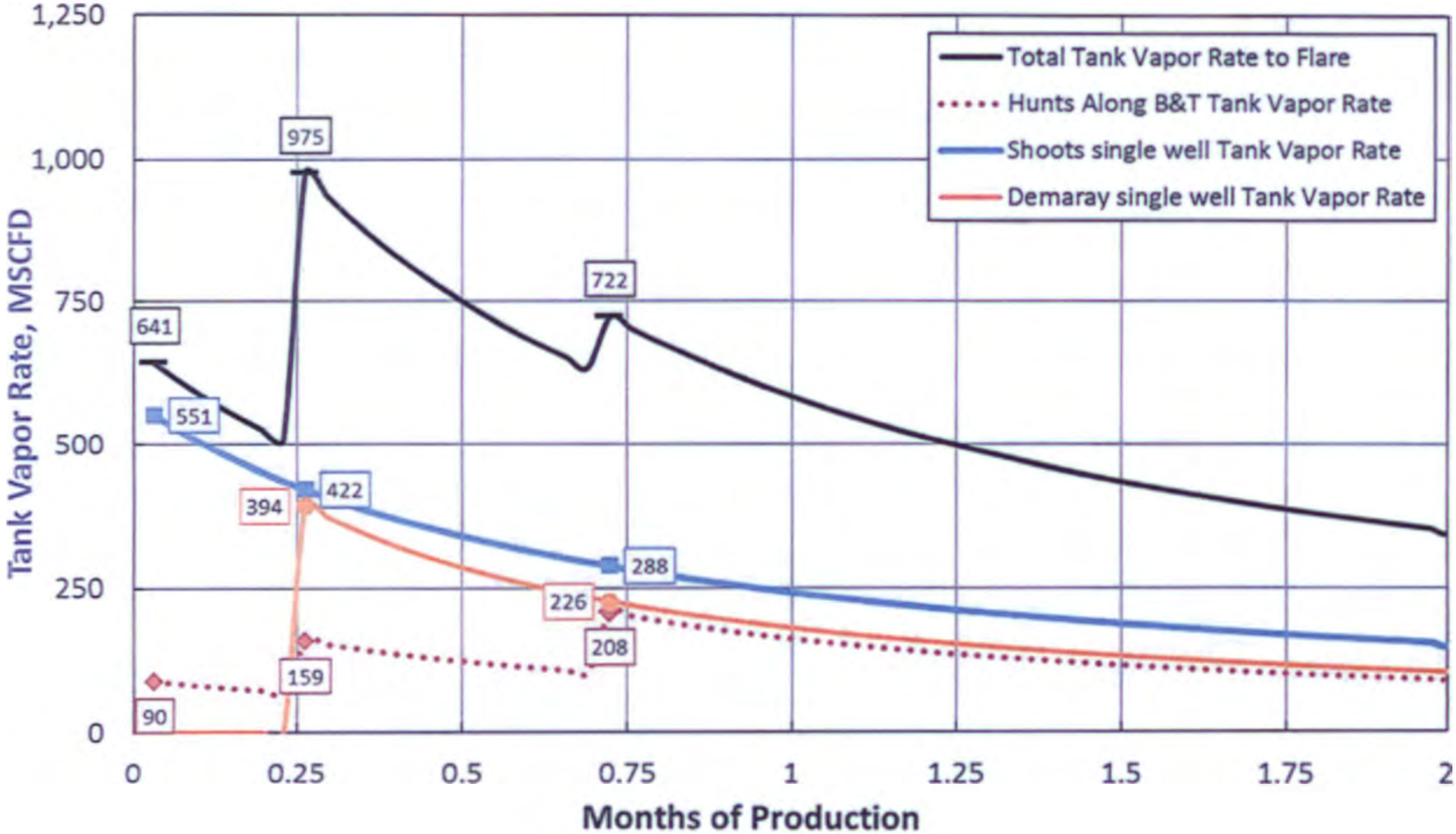
MARATHON
HP/LP Flare Capacities

Normal flow rates based on Demaray single well facility being staggered to begin production (1) week after first Hunts Along well. Shoots single well facility begins production with first Hunts Along well.



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Attachment 2 – Hunts Along Peak Rate Hydraulic Calculations

Notes ...	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
13.5 psia																	
EGMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
psia																	
psia	13.50	G	H	I	J	K	L	I	N	O	P	Q	R	I	T	U	V
or D)?	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
etherma)																	
ton)																	
ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
inches	4.000	6.000	6.000	6.000	24.000	4.000	4.000	6.000	24.000	6.000	6.000	6.000	4.000	6.000	24.000	6.000	4.000
above	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std
ft	15.0	30.0	107.0	23.0	8.0	415.0	110.0	15.0	8.0	428.0	72.0	17.0	26.0	15.0	8.0	430.0	55.0
ft																	
ft																	
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
velded																	
s		2		1		3	1				2		2	1		1	2
deg angle)																	
deg angle)																	
deg angle)																	
es																	
s			1					1		2				1		2	
le																	
gle																	
ded																	
velded																	
s																	
aded																	
r welded							2			2	1	1	1			1	1
			2				7				2						2
				1		1	1	1		1	1			1		1	1
am type)																	
s lb/ft3)^.5																	
ens lb/ft3)^.5							1				1						1
t,3=both)				1		2		1		2	1	1	1	1		2	1
in													6.000				6.000
in																	
in																	
psi	0.000	0.023															
ft fluid																	
gpm/psi^.5																	
K factor																	
lb/hr																	
gpm																	
lb/ft3																	
cP																	
dyne/cm																	
lb/hr	1155	1155	2311	666	666	666	333	922	922	922	922	922	922	723	723	723	723
lb/ft3																	
	29.14	29.14	29.140	29.140	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14
	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
4.026	6.065	6.065	6.065	23.250	4.026	4.026	6.065	23.250	6.065	6.065	6.065	4.026	6.065	23.250	6.065	4.026
Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1155	1155	2311	666	666	666	333	922	922	922	922	922	922	723	723	723	723
0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
0.00	0.01	0.07	0.10	0.10	0.20	0.31	0.10	0.11	0.13	0.17	0.18	0.21	0.10	0.10	0.12	0.17
0.0642	0.0642	0.0645	0.0647	0.0647	0.0651	0.0656	0.0647	0.0647	0.0648	0.0650	0.0650	0.0652	0.0647	0.0647	0.0647	0.0650
0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.06	0.06	0.06
0.0884	0.2006	0.2006	0.2006	2.9483	0.0884	0.0884	0.2006	2.9483	0.2006	0.2006	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884
56.57	24.90	49.61	14.25	0.97	32.11	15.93	19.73	1.34	19.69	19.64	19.62	44.43	15.49	1.05	15.47	34.97
394.75	394.53	393.80	393.26	393.24	391.84	390.30	393.25	393.22	392.83	392.30	392.13	391.69	393.25	393.23	392.99	392.26
0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.81E+05	1.20E+05	2.41E+05	6.93E+04	1.81E+04	1.04E+05	5.22E+04	9.60E+04	2.50E+04	9.60E+04	9.60E+04	9.60E+04	1.45E+05	7.53E+04	1.96E+04	7.53E+04	1.13E+05
0.0187	0.0189	0.0173	0.0207	0.0267	0.0200	0.0222	0.0196	0.0247	0.0196	0.0196	0.0196	0.0192	0.0204	0.0262	0.0204	0.0198
0.84	1.12	3.67	0.94	0.11	24.73	7.29	0.58	0.10	16.58	2.79	0.66	1.49	0.60	0.11	17.33	3.24
0.00	0.50	0.51	0.40	0.00	0.98	5.50	0.32	0.00	2.38	3.48	0.94	1.57	0.58	0.00	1.70	3.78
0.00	0.00	0.00	0.61	0.00	1.02	0.00	0.61	0.00	1.02	0.61	0.61	0.92	0.61	0.00	1.02	0.92
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.84	1.63	4.18	1.95	0.11	26.73	12.79	1.51	0.10	19.98	6.87	2.21	3.97	1.80	0.11	20.05	7.94
49.73	9.63	38.25	3.16	0.01	16.03	3.94	6.05	0.03	6.03	5.99	5.98	30.68	3.73	0.02	3.72	19.00
15.0	43.4	121.8	47.8	8.0	448.6	193.0	39.1	8.0	515.7	177.4	57.0	69.4	44.6	8.0	497.5	134.7
0.0000	**0.0297**	**0.1014**	**0.1042**	**0.10422**	**0.29817**	**0.32117**	**0.1056**	**0.10557**	**0.15977**	**0.17837**	**0.18434**	**0.23961**	**0.1045**	**0.10446**	**0.13797**	**0.20616**
0.00	**0.03**	**0.10**	**0.10**	**0.10**	**0.30**	**0.32**	**0.11**	**0.11**	**0.16**	**0.18**	**0.18**	**0.24**	**0.10**	**0.10**	**0.14**	**0.21**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
#VALUE!	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.07	0.00	0.00	0.19	0.02	0.00	0.00	0.05	0.02	0.01	0.06	0.00	0.00	0.03	0.07
3.28E-03	6.36E-04	2.53E-03	2.08E-04	9.65E-07	1.06E-03	2.60E-04	4.00E-04	1.85E-06	3.98E-04	3.96E-04	3.95E-04	2.03E-03	2.46E-04	1.14E-06	2.45E-04	1.25E-03
#VALUE!	0.03	0.07	0.00	0.00	0.19	0.02	0.00	0.00	0.05	0.02	0.01	0.06	0.00	0.00	0.03	0.07
0.00	**0.00**	**0.03**	**0.10**	**0.10**	**0.10**	**0.30**	**0.10**	**0.11**	**0.11**	**0.16**	**0.18**	**0.18**	**0.10**	**0.10**	**0.10**	**0.14**
0.0000	**0.0000**	**0.0297**	**0.1014**	**0.1042**	**0.1042**	**0.2982**	**0.1014**	**0.1056**	**0.1056**	**0.1598**	**0.1784**	**0.1843**	**0.1014**	**0.1045**	**0.1045**	**0.1380**
OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
0.057	0.025	0.050	0.014	0.001	0.033	0.016	0.020	0.001	0.020	0.020	0.020	0.045	0.016	0.001	0.016	0.035
361	361	722	208	208	208	104	288	288	288	288	288	288	226	226	226	226
361,000	361,000	722,000	208,000	208,000	208,000	104,000	288,000	288,000	288,000	288,000	288,000	288,000	226,000	226,000	226,000	226,000
15,078	15,078	30,156	8,688	8,688	8,688	4,344	12,029	12,029	12,029	12,029	12,029	12,029	9,439	9,439	9,439	9,439

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Attachment 3 – Shoots Peak Rate Hydraulic Calculations

13.5 psia	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
GMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
psia																	
psia	13.50	G	H	I	J	K	L	I	N	O	P	Q	R	I	T	U	V
or D)?	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
hermal)																	
n)																	
ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
inches	4.000	6.000	6.000	6.000	24.000	4.000	4.000	6.000	24.000	6.000	6.000	6.000	4.000	6.000	24.000	6.000	4.000
bove	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std
ft	15.0	30.0	107.0	23.0	8.0	415.0	110.0	15.0	8.0	428.0	72.0	17.0	26.0	15.0	8.0	430.0	55.0
ft																	
ft																	
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elded																	
		2		1		3	1				2		2	1		1	2
leg angle)																	
leg angle)																	
leg angle)																	
s																	
			1							2				1		2	
le																	
ed																	
elded																	
ded																	
welded							2			2	1	1	1			1	1
			2				7				2						2
				1		1	1			1	1			1		1	1
m type)																	
lb/ft3)^.5																	
s lb/ft3)^.5							1				1						1
3=both)				1		2					1	1	1	1			1
in													6.000				6.000
in																	
in																	
psi	0.000	0.019															
ft fluid																	
gpm/psi^.5																	
K factor																	
lb/hr																	
gpm																	
lb/ft3																	
cP																	
dyne/cm																	
lb/hr	1026	1026	2051	288	288	288	144	1763	1763	1763	1763	1763	1763	0	0	0	0
lb/ft3																	
	29.14	29.14	29.140	29.140	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14
	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

13.5 psia	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header
GMENT ID	G	H	I	J	K	L	M
in	4.026	6.065	6.065	6.065	23.250	4.026	4.026
	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
lb/hr	0	0	0	0	0	0	0
gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00
lb/hr	1026	1026	2051	288	288	288	144
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010
psig	0.00	0.01	0.05	0.08	0.08	0.10	0.13
lb/ft3	0.0642	0.0642	0.0644	0.0646	0.0646	0.0647	0.0648
lb/ft3	0.06	0.06	0.06	0.06	0.06	0.06	0.06
ft2	0.0884	0.2006	0.2006	0.2006	2.9483	0.0884	0.0884
ft/sec	50.22	22.11	44.09	6.18	0.42	14.00	6.99
ft/sec	394.75	394.57	393.98	393.56	393.55	393.26	392.92
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.61E+05	1.07E+05	2.14E+05	3.00E+04	7.82E+03	4.52E+04	2.26E+04
	0.0190	0.0193	0.0176	0.0243	0.0331	0.0228	0.0261
	0.85	1.14	3.72	1.10	0.14	28.21	8.57
	0.00	0.50	0.51	0.42	0.00	1.02	5.63
	0.00	0.00	0.00	0.61	0.00	1.02	0.00
Cv)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.85	1.65	4.23	2.14	0.14	30.25	14.21
ft fluid	39.19	7.60	30.20	0.59	0.00	3.04	0.76
ft	15.0	43.2	121.7	44.6	8.0	445.0	182.3
psig	**0.0000**	**0.0243**	**0.0816**	**0.0822**	**0.08216**	**0.12351**	**0.12836**
psi							
psig	**0.00**	**0.02**	**0.08**	**0.08**	**0.08**	**0.12**	**0.13**
psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	#VALUE!	0.02	0.00	0.00	0.00	0.00	0.00
psi	0.01	0.01	0.06	0.00	0.00	0.04	0.00
	2.59E-03	5.02E-04	1.99E-03	3.91E-05	1.81E-07	2.01E-04	5.01E-05
psi	#VALUE!	0.02	0.06	0.00	0.00	0.04	0.00
psig	**0.00**	**0.00**	**0.02**	**0.08**	**0.08**	**0.08**	**0.12**
psi							
psig	**0.0000**	**0.0000**	**0.0243**	**0.0816**	**0.0822**	**0.0822**	**0.1235**
	OK	OK	OK	OK	OK	OK	OK
M	0.051	0.022	0.045	0.006	0.000	0.014	0.007
V[Mscfd]	321	321	641	90	90	90	45
V[scfd]	320,500	320,500	641,000	90,000	90,000	90,000	45,000
V[scfhAIR]	13,386	13,386	26,773	3,759	3,759	3,759	1,880

13.5 psia	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
GMENT ID	N	O	P	Q	R	S	T	U	V	W
in	6.065	23.250	6.065	6.065	6.065	4.026	6.065	23.250	6.065	4.026
	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
lb/hr	0	0	0	0	0	0	0	0	0	0
gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
lb/hr	1763	1763	1763	1763	1763	1763	0	0	0	0
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.000	0.000	0.000	0.000
psig	0.08	0.09	0.17	0.29	0.34	0.44	0.08	0.08	0.08	0.08
lb/ft3	0.0646	0.0646	0.0650	0.0656	0.0658	0.0663	0.0000	0.0000	0.0000	0.0000
lb/ft3	0.06	0.06	0.06	0.07	0.07	0.07	0.00	0.00	0.00	0.00
ft2	0.2006	2.9483	0.2006	0.2006	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884
ft/sec	37.81	2.57	37.56	37.24	37.12	83.59	0.00	0.00	0.00	0.00
ft/sec	393.52	393.49	392.24	390.54	389.93	388.42	0.00	0.00	0.00	0.00
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.000	0.000	0.000	0.000
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.84E+05	4.79E+04	1.84E+05	1.84E+05	1.84E+05	2.77E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	0.0179	0.0214	0.0179	0.0179	0.0179	0.0180	0.0000	0.0000	0.0000	0.0000
	0.53	0.09	15.14	2.55	0.60	1.40	0.00	0.00	0.00	0.00
	0.00	0.00	2.37	3.45	0.94	1.56	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.61	0.61	0.92	0.00	0.00	0.00	0.00
Cv)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.53	0.09	17.51	6.61	2.15	3.87	0.00	0.00	0.00	0.00
ft fluid	22.21	0.10	21.92	21.55	21.41	108.58	0.00	0.00	0.00	0.00
ft	15.0	8.0	495.0	186.8	60.7	72.1	0.0	0.0	0.0	0.0
psig	**0.0869**	**0.08689**	**0.26046**	**0.32540**	**0.34642**	**0.54137**	**0.0816**	**0.08159**	**0.08159**	**0.08159**
psi										
psig	**0.09**	**0.09**	**0.26**	**0.33**	**0.35**	**0.54**	**0.08**	**0.08**	**0.08**	**0.08**
psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	0.01	0.00	0.17	0.06	0.02	0.19	0.00	0.00	0.00	0.00
	1.47E-03	6.79E-06	1.45E-03	1.42E-03	1.41E-03	7.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
psi	0.01	0.00	0.17	0.06	0.02	0.19	0.00	0.00	0.00	0.00
psig	**0.08**	**0.09**	**0.09**	**0.26**	**0.33**	**0.35**	**0.08**	**0.08**	**0.08**	**0.08**
psi										
psig	**0.0816**	**0.0869**	**0.0869**	**0.2605**	**0.3254**	**0.3464**	**0.0816**	**0.0816**	**0.0816**	**0.0816**
	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
M	0.038	0.003	0.038	0.038	0.038	0.085	NA	NA	NA	NA
V[Mscfd]	551	551	551	551	551	551	0	0	0	0
V[scfd]	551,000	551,000	551,000	551,000	551,000	551,000	0	0	0	0
V[scfhAIR]	23,014	23,014	23,014	23,014	23,014	23,014	0	0	0	0

HALKER
CONSULTING

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Attachment 4 – Demaray Peak Rate Hydraulic Calculations

13.5	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
psia																	
GMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
psia																	
psia	13.50	G	H	I	J	K	L	I	N	O	P	Q	R	I	T	U	V
or D)?	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
thermal)																	
on)																	
ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
inches	4.000	6.000	6.000	6.000	24.000	4.000	4.000	6.000	24.000	6.000	6.000	6.000	4.000	6.000	24.000	6.000	4.000
bove	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std
ft	15.0	30.0	107.0	23.0	8.0	415.0	110.0	15.0	8.0	428.0	72.0	17.0	26.0	15.0	8.0	430.0	55.0
ft																	
ft																	
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elded																	
		2		1		3	1				2		2	1		1	2
deg angle)																	
deg angle)																	
deg angle)																	
es																	
			1					1		2				1		2	
le																	
led																	
elded																	
ded																	
welded							2			2	1	1	1			1	1
			2				7				2						2
				1		1	1	1		1	1			1		1	1
m type)																	
lb/ft3)^.5																	
ns lb/ft3)^.5							1				1						1
3=both)				1		2		1		2	1	1	1	1		2	1
in													6.000				6.000
in																	
in																	
psi	0.000	0.037															
ft fluid																	
gpm/psi^.5																	
K factor																	
lb/hr																	
gpm																	
lb/ft3																	
cP																	
dyne/cm																	
lb/hr	1560	1560	3120	509	509	509	254	1350	1350	1350	1350	1350	1350	1261	1261	1261	1261
lb/ft3																	
	29.14	29.14	29.140	29.140	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14
	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

13.5 psia	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
GMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
in	4.026	6.065	6.065	6.065	23.250	4.026	4.026	6.065	23.250	6.065	6.065	6.065	4.026	6.065	23.250	6.065	4.026
	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
lb/hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
lb/hr	1560	1560	3120	509	509	509	254	1350	1350	1350	1350	1350	1350	1261	1261	1261	1261
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
psig	0.00	0.02	0.11	0.18	0.18	0.24	0.30	0.18	0.19	0.24	0.31	0.34	0.40	0.18	0.19	0.23	0.38
lb/ft3	0.0642	0.0643	0.0647	0.0650	0.0650	0.0653	0.0656	0.0650	0.0651	0.0653	0.0657	0.0658	0.0661	0.0650	0.0651	0.0653	0.0660
lb/ft3	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
ft2	0.0884	0.2006	0.2006	0.2006	2.9483	0.0884	0.0884	0.2006	2.9483	0.2006	0.2006	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884
ft/sec	76.39	33.60	66.76	10.84	0.74	24.48	12.18	28.75	1.96	28.63	28.47	28.42	64.20	26.84	1.83	26.74	60.05
ft/sec	394.75	394.39	393.11	392.18	392.17	391.34	390.41	392.13	392.07	391.29	390.23	389.87	388.97	392.13	392.07	391.40	389.33
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2.45E+05	1.62E+05	3.25E+05	5.30E+04	1.38E+04	7.98E+04	3.99E+04	1.41E+05	3.67E+04	1.41E+05	1.41E+05	1.41E+05	2.12E+05	1.31E+05	3.43E+04	1.31E+05	1.98E+05
	0.0182	0.0182	0.0168	0.0217	0.0285	0.0208	0.0233	0.0185	0.0226	0.0185	0.0185	0.0185	0.0184	0.0187	0.0230	0.0187	0.0186
	0.81	1.08	3.56	0.99	0.12	25.69	7.65	0.55	0.09	15.68	2.64	0.62	1.43	0.55	0.09	15.90	3.04
	0.00	0.50	0.51	0.41	0.00	0.99	5.53	0.32	0.00	2.37	3.46	0.94	1.56	0.57	0.00	1.69	3.77
	0.00	0.00	0.00	0.61	0.00	1.02	0.00	0.61	0.00	1.01	0.61	0.61	0.92	0.61	0.00	1.01	0.92
Cv)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.81	1.58	4.07	2.01	0.12	27.70	13.18	1.48	0.09	19.06	6.71	2.17	3.91	1.74	0.09	18.60	7.73
ft fluid	90.68	17.54	69.27	1.82	0.01	9.32	2.31	12.85	0.06	12.74	12.60	12.55	64.06	11.20	0.05	11.12	56.04
ft	15.0	43.9	122.3	46.7	8.0	447.5	189.6	40.4	8.0	520.5	183.1	59.2	71.1	47.0	8.0	503.1	139.6
psig	**0.0000**	**0.0493**	**0.1765**	**0.1781**	**0.17812**	**0.29519**	**0.30905**	**0.1851**	**0.18506**	**0.29529**	**0.33386**	**0.34631**	**0.46171**	**0.1853**	**0.18525**	**0.27986**	**0.47816**
psi																	
psig	**0.00**	**0.05**	**0.18**	**0.18**	**0.18**	**0.30**	**0.31**	**0.19**	**0.19**	**0.30**	**0.33**	**0.35**	**0.46**	**0.19**	**0.19**	**0.28**	**0.48**
psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	#VALUE!	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	0.03	0.01	0.13	0.00	0.00	0.12	0.01	0.01	0.00	0.11	0.04	0.01	0.11	0.01	0.00	0.09	0.20
	5.99E-03	1.16E-03	4.57E-03	1.20E-04	5.58E-07	6.15E-04	1.52E-04	8.48E-04	3.93E-06	8.41E-04	8.32E-04	8.29E-04	4.23E-03	7.39E-04	3.42E-06	7.34E-04	3.70E-03
psi	#VALUE!	0.05	0.13	0.00	0.00	0.12	0.01	0.01	0.00	0.11	0.04	0.01	0.12	0.01	0.00	0.09	0.20
psig	**0.00**	**0.00**	**0.05**	**0.18**	**0.18**	**0.18**	**0.30**	**0.18**	**0.19**	**0.19**	**0.30**	**0.33**	**0.35**	**0.18**	**0.19**	**0.19**	**0.28**
psi																	
psig	**0.0000**	**0.0000**	**0.0493**	**0.1765**	**0.1781**	**0.1781**	**0.2952**	**0.1765**	**0.1851**	**0.1851**	**0.2953**	**0.3339**	**0.3463**	**0.1765**	**0.1853**	**0.1853**	**0.2791**
	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
M	0.077	0.034	0.068	0.011	0.001	0.025	0.012	0.029	0.002	0.029	0.029	0.029	0.065	0.027	0.002	0.027	0.061
V[Mscfd]	488	488	975	159	159	159	80	422	422	422	422	422	422	394	394	394	394
V[scfd]	487,500	487,500	975,000	159,000	159,000	159,000	79,500	422,000	422,000	422,000	422,000	422,000	422,000	394,000	394,000	394,000	394,000
V[scfhAIR]	20,361	20,361	40,723	6,641	6,641	6,641	3,320	17,826	17,826	17,826	17,826	17,826	17,826	16,456	16,456	16,456	16,456

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Attachment 5 -Maximum Flow Rate Hydraulic Calculations

13.5 psia	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
GMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
psia																	
psia	13.50	G	H	I	J	K	L	I	N	O	P	Q	R	I	T	U	V
or D)?	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
thermal)																	
on)																	
ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
inches	4.000	6.000	6.000	6.000	24.000	4.000	4.000	6.000	24.000	6.000	6.000	6.000	4.000	6.000	24.000	6.000	4.000
bove	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std	std
ft	15.0	30.0	107.0	23.0	8.0	415.0	110.0	15.0	8.0	428.0	72.0	17.0	26.0	15.0	8.0	430.0	55.0
ft																	
ft																	
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elded																	
		2		1		3	1				2		2	1		1	2
deg angle)																	
deg angle)																	
deg angle)																	
es																	
			1					1		2				1		2	
gle																	
ded																	
elded																	
ded																	
welded							2			2	1	1	1			1	1
			2				7				2						2
				1		1	1	1		1	1			1		1	1
m type)																	
lb/ft3)^.5																	
ns lb/ft3)^.5							1				1						1
,3=both)				1		2		1		2	1	1	1	1		2	1
in													6.000				6.000
in																	
in																	
psi	0.000	0.060															
ft fluid																	
gpm/psi^.5																	
K factor																	
lb/hr																	
gpm																	
lb/ft3																	
cP																	
dyne/cm																	
lb/hr	2085	2085	4170	752	752	752	376	1993	1993	1993	1993	1993	1993	1425	1425	1425	1425
lb/ft3																	
	29.14	29.14	29.140	29.140	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14
	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

13.5 psia	atm flare stack and tip	Downstream of 1st Flare	Common Discharge	Hunts Along KO Outlet	Hunts Along KO Drum	Hunts Along Flare Header	Fr Rw Hunts Along Vent Header	Shoots KO Outlet	Shoots KO Drum	Shoots Flare Header	Shoots T-5040 Vent Header	Shoots T-5050 Vent Jumper	Shoots T-5560 Vent Jumper	Demaray KO Outlet	Demaray KO Drum	Demaray Flare Header	Demaray Vent Header
SEGMENT ID	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
in	4.026	6.065	6.065	6.065	23.250	4.026	4.026	6.065	23.250	6.065	6.065	6.065	4.026	6.065	23.250	6.065	4.026
	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
lb/hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
lb/hr	2085	2085	4170	752	752	752	376	1993	1993	1993	1993	1993	1993	1425	1425	1425	1425
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
psig	0.00	0.04	0.19	0.31	0.31	0.43	0.56	0.31	0.32	0.44	0.59	0.64	0.78	0.31	0.31	0.37	0.56
lb/ft3	0.0642	0.0644	0.0651	0.0656	0.0656	0.0662	0.0668	0.0657	0.0657	0.0662	0.0670	0.0672	0.0679	0.0656	0.0657	0.0659	0.0668
lb/ft3	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
ft2	0.0884	0.2006	0.2006	0.2006	2.9483	0.0884	0.0884	0.2006	2.9483	0.2006	0.2006	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884
ft/sec	102.08	44.84	88.69	15.87	1.08	35.70	17.68	42.02	2.86	41.65	41.19	41.04	92.25	30.05	2.04	29.91	67.00
ft/sec	394.75	394.16	391.97	390.36	390.34	388.65	386.79	390.26	390.13	388.54	386.41	385.68	383.86	390.31	390.23	389.41	386.86
cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3.27E+05	2.17E+05	4.34E+05	7.83E+04	2.04E+04	1.18E+05	5.90E+04	2.08E+05	5.41E+04	2.08E+05	2.08E+05	2.08E+05	3.13E+05	1.48E+05	3.87E+04	1.48E+05	2.24E+05
	0.0178	0.0175	0.0164	0.0202	0.0259	0.0197	0.0218	0.0176	0.0208	0.0176	0.0176	0.0176	0.0178	0.0184	0.0224	0.0184	0.0184
	0.80	1.04	3.48	0.92	0.11	24.34	7.14	0.52	0.09	14.93	2.51	0.59	1.38	0.55	0.09	15.64	3.01
	0.00	0.50	0.51	0.40	0.00	0.98	5.49	0.32	0.00	2.37	3.45	0.94	1.56	0.57	0.00	1.69	3.76
	0.00	0.00	0.00	0.61	0.00	1.02	0.00	0.61	0.00	1.01	0.61	0.61	0.92	0.61	0.00	1.01	0.92
e Cv)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.80	1.54	3.98	1.93	0.11	26.33	12.63	1.45	0.09	18.31	6.57	2.14	3.86	1.73	0.09	18.34	7.69
ft fluid	161.93	31.25	122.25	3.91	0.02	19.81	4.86	27.44	0.13	26.95	26.37	26.17	132.25	14.04	0.06	13.91	69.76
ft	15.0	44.3	122.6	48.3	8.0	449.1	194.6	41.6	8.0	525.0	188.4	61.3	72.5	47.5	8.0	504.3	140.5
psig	0.0000	0.0815	0.3034	0.3069	0.30685	0.54696	0.57545	0.3216	0.32160	0.54900	0.62971	0.65587	0.89845	0.3145	0.31446	0.43134	0.68136
psi																	
psig	0.00	0.08	0.30	0.31	0.31	0.55	0.58	0.32	0.32	0.55	0.63	0.66	0.90	0.31	0.31	0.43	0.68
psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	#VALUE!	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
psi	0.06	0.02	0.22	0.00	0.00	0.24	0.03	0.02	0.00	0.23	0.08	0.03	0.24	0.01	0.00	0.12	0.25
	1.07E-02	2.06E-03	8.07E-03	2.58E-04	1.20E-06	1.31E-03	3.21E-04	1.81E-03	8.38E-06	1.78E-03	1.74E-03	1.73E-03	8.73E-03	9.27E-04	4.29E-06	9.18E-04	4.61E-03
psi	#VALUE!	0.08	0.22	0.00	0.00	0.24	0.03	0.02	0.00	0.23	0.08	0.03	0.24	0.01	0.00	0.12	0.25
psig	0.00	0.00	0.08	0.30	0.31	0.31	0.55	0.30	0.32	0.32	0.55	0.63	0.66	0.30	0.31	0.31	0.43
psi																	
psig	0.0000	0.0000	0.0815	0.3034	0.3069	0.3069	0.5470	0.3034	0.3216	0.3216	0.5490	0.6297	0.6559	0.3034	0.3145	0.3145	0.4313
	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
M	0.103	0.046	0.091	0.016	0.001	0.036	0.018	0.043	0.003	0.043	0.042	0.042	0.094	0.030	0.002	0.030	0.068
V[Mscfd]	651	651	1303	235	235	235	118	623	623	623	623	623	623	445	445	445	445
V[scfd]	651,445	651,445	1,302,890	235,040	235,040	235,040	117,520	622,630	622,630	622,630	622,630	622,630	622,630	445,220	445,220	445,220	445,220
V[scfhAIR]	27,209	27,209	54,418	9,817	9,817	9,817	4,908	26,005	26,005	26,005	26,005	26,005	26,005	18,596	18,596	18,596	18,596

Earl Pennigton USA Pad (Kattevold CTB)

Kattevold USA CTB Vent Line Design & Capacity Assessment

TO:	Marathon Oil
FROM:	Tim Archuleta
CC:	Nate Mascarenas, Kendra Meeker
DATE:	July 17, 2017
RE:	Kattevold USA CTB- Vent Line Design and Capacity Assessment

(b) (6) [redacted]

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Kattevold USA CTB tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2, will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to two flares where the off gas will be combusted to meet Quad Oa regulations.

This tank battery is comprised of two different production trains: the Kattevold USA CTB and Alexander USA single well facility with separate tank vent headers and flare knock out drums which then combine into a single flare header that flows to two flares.

Results:

Based on the 3D model (dated 7/6/17) of the vent systems and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.5 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated for each of the well pads with the following results:

Kattevold USA CTB:	6.3 oz/in^2g
Alexander USA single well facility:	3.7 oz/in^2g

Calculations:

A flare tip pressure drop of 0.0 oz/in² was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.64 oz/in² and is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

Because this tank vent system is composed of two individual production trains each having their own peak rate, two total system peak rates were evaluated corresponding to the peak rates from each individual production train. It was determined that the worst case scenario exists when the total gas flow rate was 1,022 Mscfd (3,271 lb/hr) which corresponds to the Kattevold production train peak rate. The tank gas flow rate is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 1,584 Mscfd and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in²). This is approximately 1.55 times the normal flow. The flow was increased by an equal factor of 55% applied to the maximum forecast tank vapor rates for each of the two trains.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

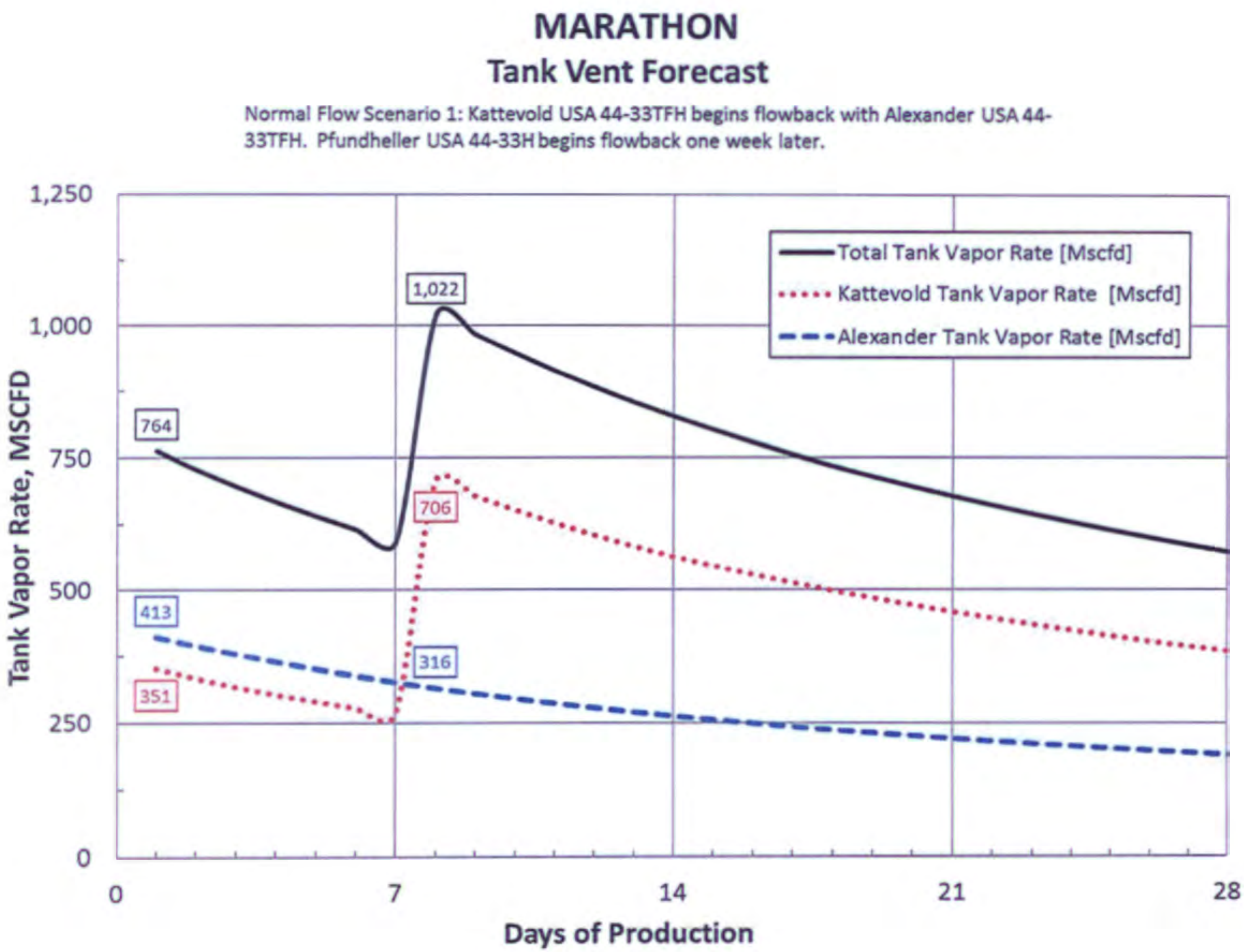
Attachment 1 - Normal Hydraulic Calculations

Hydraulic Calculations												
Client: Meridian Oil	Basis / Notes -->											
Project: Kattevold CTB												
Location:												
Unit: TVCS Normal Flow Calculations												
Proj#: 16039-17	Atm Pres 13.5	3rd flare tip	DNB 1st flare	DNB commingle	Katt. KO Outlet	Katt. KO Drum	Katt. Flare Header	Katt. Vent Header	Alex. KO Outlet	Alex. KO Drum	Alex. Flare Header	Alex. Vent Header
By/Chk'd	Pres Unit psia											
Rev/Date 12-Jul-17	SEGMENT ID	G	H	I	J	K	L	M	N	O	P	Q
Pressure Data: Upstream Segment ID or known press.	psia											
Pressure Data: Downstream Segment ID or known press.	psia	13.50	G	H	I	J	K	L	I	N	O	P
Pressure Data: Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	d	d	d
Fric Method (1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=Isothermal)												
Holdup Meth (blank=default 2 =Hughmark, 3=L-M, 4=B&B, 5=Eaton)												
Pipe: Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
Pipe: Nominal Line Size or Internal Diameter	inches	4.000	6.000	6.000	6.000	24.000	6.000	6.000	6.000	24.000	6.000	6.000
Pipe: Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	std	std	std
Pipe: Straight pipe length	ft	20.0	70.0	72.0	50.0	4.0	210.0	79.0	10.0	4.0	300.0	62.0
Elevation: Inlet & Outlet OR — Inlet	ft											
Elevation: Outlet	ft											
Elevation: Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3K Method — 90's: Std (R/D=1), threaded												
90's: Short Radius (R/D=1), flgd/welded												
90's: Standard (R/D=1.5), all types			1		2		3	2			3	2
Mitered: 1 weld (90 deg angle)												
Mitered: 2 weld (45 deg angle)												
Mitered: 3 weld (30 deg angle)												
Choose type: Plug Valve Branch Flow												
Choose type: Plug Valve Straight Thru												
Elbows — 45's: Short Radius (R/D=1), all types												
45's: Standard (R/D=1.5), all types												
45's: Mitered, 1 weld, 45 deg angle												
45's: Mitered, 2 weld, 22.5 deg angle												
Choose type: Ball Valve Full Port												
180's: Close Return (R/D=1), threaded												
180's: Close Return (R/D=1), flgd/welded												
180: Standard (R/D=1.5), all types												
Tees — Used as an Elbow: Standard (R/D=1), threaded												
Used as an Elbow: Long-radius (R/D=1.5), threaded												
Used as an Elbow: Standard (R/D=1), flanged or welded							1	2	1		2	2
Used as an Elbow: Stub-in type branch												
Flow-thru Tee: Threaded												
Flow-thru Tee: Flanged or Welded				2	1		1	2	1		1	1
Flow-thru Tee: Stub-in type branch												
Valves — Gate, Ball or Plug: Full line size, Beta=1.0			1		1		1	1	1		1	1
Gate, Ball or Plug: Reduced trim, Beta=0.9												
Gate, Ball or Plug: Reduced trim, Beta=0.8												
Globe, standard												
Globe - (Angle or Y-type) or Diaphragm (dam type)												
Butterfly												
Check: Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5												
Check: Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1				1
Check: Tilting-disk												
Other DP: Pipe Entrance/Exit? (0=none, 1=entr., 2=exit, 3=both)					1		3	1	1		3	1
Other DP: Swage to Diameter (at end)	in											
Other DP: Orifice Diameter	in											
Other DP: Initial Swage from Diameter	in											
Other DP: Other Pressure Drop (Equip. etc.)	psi	0.808	0.840									
Other DP: Other Head Pressure Drop (Equip. etc.)	ft fluid											
Other DP: Valve Cv (Non-flashing liquid only!)	gpm/psi^.5											
Other DP: Miscellaneous Flow Resistance	K factor											
Liquid: Flow (provide mass OR volume basis)	lb/hr											
Liquid: Flow	gpm											
Liquid: Density	lb/ft3											
Liquid: Viscosity	cP											
Liquid: Surface Tension (2 phase only)	dyne/cm											
Vapor: Flow Rate	lb/hr	1,635	1,635	3,271	2,259	2,259	2,259	1,130	1,011	1,011	1,011	674
Vapor: Density OR MW, Z & T — Density	lb/ft3											
Vapor: MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14
Vapor: Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
Vapor: Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0
Vapor: Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Pipe Internal Diameter	in	4.026	6.065	6.065	6.065	23.250	6.065	6.065	6.065	23.250	6.065	6.065
DP / Holdup Calculation Methods		Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh
Liquid: Flow rate	lb/hr	0	0	0	0	0	0	0	0	0	0	0
Liquid: Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquid: Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquid: Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquid: Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vapor: Flow Rate	lb/hr	1635	1635	3271	2259	2259	2259	1130	1011	1011	1011	674
Vapor: Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Vapor: Segment Average Pressure	psig	0.00	0.03	0.11	0.18	0.20	0.28	0.38	0.16	0.17	0.19	0.22
Vapor: Vapor Density (Avg)	lb/ft3	0.0642	0.0643	0.0647	0.0650	0.0651	0.0655	0.0660	0.0649	0.0650	0.0651	0.0652
Flow Parameters: Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.06	0.06	0.07	0.07
Flow Parameters: Pipe Flow Area	ft2	0.0884	0.2006	0.2006	0.2006	2.9483	0.2006	0.2006	0.2006	2.9483	0.2006	0.2006
Flow Parameters: Bulk Velocity	ft/sec	80.07	35.20	69.99	48.11	3.27	47.75	23.71	21.56	1.47	21.51	14.31
Flow Parameters: Erosional Velocity if solids present	ft/sec	394.75	394.28	393.13	392.17	391.89	390.71	389.32	392.41	392.35	391.98	391.52
Flow Parameters: Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Flow Parameters: Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Parameters: Reynolds Number (NRe)		2.57E+05	1.70E+05	3.41E+05	2.35E+05	6.14E+04	2.35E+05	1.18E+05	1.05E+05	2.75E+04	1.05E+05	7.02E+04
Flow Parameters: Friction Factor f (Colebrook & White)		0.0181	0.0181	0.0168	0.0174	0.0203	0.0174	0.0190	0.0193	0.0242	0.0193	0.0206
Friction: K (straight pipe)		1.08	2.50	2.39	1.03	0.04	7.22	2.97	0.38	0.05	12.22	2.57
Friction: K (fittings + valves)		0.00	0.39	0.33	0.81	0.00	1.99	4.41	1.25	0.00	2.95	4.27
Friction: K (entrance + exit + swages + orifice)		0.00	0.00	0.00	0.61	0.00	1.01	0.61	0.61	0.00	1.02	0.61
Friction: K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Friction: Total K		1.08	2.89	2.72	2.45	0.04	10.23	7.98	2.24	0.05	16.19	7.45
Velocity Head (Average Density Basis)	ft fluid	99.63	19.25	76.12	35.97	0.17	35.44	8.73	7.22	0.03	7.19	3.18
Equivalent length	ft	20.0	81.0	82.1	71.2	4.0	297.4	212.5	56.8	4.0	423.8	182.6
TOTAL: Upstream Pressure before CV	psig	0.0	0.1	0.2	0.2	0.2	0.4	0.4	0.2	0.2	0.2	0.2
TOTAL: Available Upstream Control Valve DP	psi											
TOTAL: Segment Upstream pressure	psig	0.00	0.06	0.16	0.20	0.20	0.36	0.40	0.17	0.17	0.22	0.23
TOTAL: Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL: Other Pressure Drop (Equip & Allow)	psi	#VALUE!	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL: Friction Pressure Drop	psi	0.05	0.02	0.09	0.04	0.00	0.16	0.03	0.01	0.00	0.05	0.01
TOTAL: Acceleration Factor		6.58E-03	1.27E-03	5.03E-03	2.37E-03	1.10E-05	2.34E-03	5.77E-04	4.77E-04	2.21E-06	4.75E-04	2.10E-04
TOTAL: Total System Pressure Drop	psi	#VALUE!	0.06	0.09	0.04	0.00	0.17	0.03	0.01	0.00	0.05	0.01
TOTAL: Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.06	0.16	0.20	0.20	0.36	0.16	0.17	0.17	0.22
TOTAL: Available Downstream Control Valve DP	psi											
TOTAL: Pressure after Control Valve	psig	0.0000	0.0000	0.0647	0.1582	0.1980	0.1980	0.3633	0.1582	0.1655	0.1655	0.2181
TOTAL: Error Status		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
	V [Mscfd]	511	511	1,022	706	706	706	353	316	316	316	211
	V [scfh/AIR]	21,343	21,343	42,686	29,488	29,488	29,488	14,744	13,198	13,198	13,198	8,799

Katt. | Alex.

0.3 osig | 3.7 osig

Attachment 2 - Normal Tank Vapor Forecast


MARATHON
Tank Vent Forecast
Normal Flow Scenario 1: Kattevold USA 44-33TFH begins flowback with Alexander USA 44-33TFH. Pfundheller USA 44-33H begins flowback one week later.
1,250
1,000
750
500
250
0
Tank Vapor Rate, MSCFD
0
7
14
21
28
Days of Production
Total Tank Vapor Rate [Mscfd]
Kattevold Tank Vapor Rate [Mscfd]
Alexander Tank Vapor Rate [Mscfd]
1,022
764
706
413
316
351

Attachment 3 - Maximum Rated Capacity Hydraulic Calculations

	Hydraulic Calculations														
Client	Marathon Oil	Basis /													
Project	Kattevold CTB	Notes -->													
Location															
Unit	TVCS Maximum Flow Calculations														
Proj #	16039-17	Atm Pres 13.5	2nd flare ko	DNS 1st flare	DNS commingle	Katt. KO Outlet	Katt. KO Drum	Katt. Flare Header	Katt. Vent Header	Alex KO Outlet	Alex KO Drum	Alex Flare Header	Alex Vent Header	Katt.	Alex
By/Chk'd		Pres Unit psia													
Rev/Date	12-Jul-17	SEGMENT ID	G	H	I	J	K	L	M	N	O	P	Q		
Pressure Data	Upstream Segment ID or known press.	psia													
	Downstream Segment ID or known press	psia	13.50	G	H	I	J	K	L	I	N	O	P		
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	d	d	d		
Fric Method	(blank/1=Darcy, 2=Fanning...)														
Holdup Mth	(blank=default,2 =Hughmark,3=L-M,4=BBB,5=Eaton)														
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015		
	Nominal Line Size or Internal Diameter	inches	4.000	6.000	6.000	6.000	24.000	6.000	6.000	6.000	24.000	6.000	6.000		
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	std	std	std		
	Straight pipe length	ft	20.0	70.0	72.0	30.0	4.0	210.0	79.8	10.0	4.0	320.0	63.5		
Elevation	Inlet & Outlet — Inlet	ft													
	OR — Outlet	ft													
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
3K Method	90's — Std (R/D=1), threaded														
	90's — Short Radius (R/D=1), flgd/welded														
	90's — Standard (R/D=1.5), all types			1		2		3	2			1	2		
	Mitered — 1 weld (90 deg angle)														
	Mitered — 2 weld (45 deg angle)														
	Mitered — 3 weld (30 deg angle)														
Elbows	Choose type: Plug Valve Branch Flow														
	Choose type: Plug Valve Straight Thru														
	45's — Short Radius (R/D=1), all types														
	45's — Standard (R/D=1.5), all types														
	Mitered, 1 weld, 45 deg angle														
	Mitered, 2 weld, 22.5 deg angle														
	Choose type: Ball Valve Full Port														
	180's — Close Return (R/D=1), threaded														
	180's — Close Return (R/D=1), flgd/welded														
	180 — Standard (R/D=1.5), all types														
Tees	Used as an Elbow — Standard (R/D=1), threaded														
	Long-radius (R/D=1.5), threaded														
	Standard (R/D=1), flanged or welded							1	2	1		2	2		
	Stub-in type branch														
	Flow-thru Tee — Threaded														
	Flanged or Welded				2	1		1	2	1		1	1		
	Stub-in type branch														
Valves	Gate, Ball or Plug — Full line size, Beta=1.0			1		1		1	1	1		1	1		
	Reduced trim, Beta=0.9														
	Reduced trim, Beta=0.8														
	Globe, standard														
	Globe - (Angle or Y-type) or Diaphragm (dam type)														
	Butterfly														
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5														
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1				1		
	Tilting-disk														
Other DP	Pipe Entrance/Exit? (0=none,1=entr., 2=exit,3=both)					1		2	1	1		2	1		
	Swage to Diameter (at end)	in		4.000											
	Orifice Diameter	in													
	Initial Swage from Diameter	in													
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.084											
	Other Head Pressure Drop (Equip, etc.)	ft fluid													
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5													
	Miscellaneous Flow Resistance	K factor													
Liquid	Flow (provide mass OR volume basis)	lb/hr													
		gpm													
	Density	lb/ft3													
	Viscosity	cP													
	Surface Tension (2 phase only)	dyne/cm													
Vapor	Flow Rate	lb/hr	2,535	2,535	5,069	3,502	3,502	3,502	1,751	1,567	1,567	1,567	1,045		
	Density OR MW, Z & T — Density	lb/ft3													
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14		
	Z		0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986	0.986		
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0		
	Vapor Viscosity	cP	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009		
Pipe Internal Diameter		in	4.026	6.065	6.065	6.065	23.250	6.065	6.065	6.065	23.250	6.065	6.065		
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh		
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	0	0	0		
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Vapor	Flow Rate	lb/hr	2535	2535	5069	3502	3502	3502	1751	1567	1567	1567	1045		
	Vapor Viscosity	cP	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009		
	Segment Average Pressure	psig	0.00	0.07	0.26	0.41	0.45	0.64	0.86	0.37	0.38	0.44	0.51		
	Vapor Density (Avg)	lb/ft3	0.0647	0.0650	0.0659	0.0666	0.0669	0.0677	0.0688	0.0665	0.0665	0.0668	0.0671		
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		
	Pipe Flow Area	ft2	0.0884	0.2006	0.2006	0.2006	2.9483	0.2006	0.2006	0.2006	2.9483	0.2006	0.2006		
	Bulk Velocity	ft/sec	123.13	53.96	106.50	72.76	4.94	71.57	35.23	32.66	2.22	32.50	21.56		
	Erosional Velocity if solids present	ft/sec	393.20	392.12	389.53	387.38	386.74	384.20	381.23	387.90	387.78	386.97	386.00		
	Average Viscosity	cP	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009		
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Reynolds Number (NRe)		4.47E+05	2.97E+05	5.93E+05	4.10E+05	1.07E+05	4.10E+05	2.05E+05	1.83E+05	4.78E+04	1.83E+05	1.22E+05		
	Friction Factor f (Colebrook & White)		0.0174	0.0170	0.0161	0.0165	0.0182	0.0165	0.0177	0.0179	0.0214	0.0179	0.0189		
Friction	K (straight pipe)		1.04	2.35	2.29	0.98	0.04	6.85	2.76	0.35	0.04	11.32	2.35		
	K (fittings + valves)		0.00	0.39	0.33	0.80	0.00	1.98	4.39	1.25	0.00	2.93	4.24		
	K (entrance + exit + swages + orifice)		0.00	0.43	0.00	0.61	0.00	1.01	0.61	0.61	0.00	1.01	0.61		
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Total K		1.04	3.17	2.62	2.39	0.04	9.85	7.75	2.21	0.04	15.27	7.20		
	Velocity Head (Average Density Basis)	ft fluid	235.63	45.25	176.25	82.28	0.38	79.51	19.29	16.57	0.08	16.41	7.22		
	Equivalent length	ft	20.0	94.4	82.5	73.2	4.0	301.8	222.0	62.5	4.0	431.5	192.7		
TOTAL	Upstream Pressure before CV	psig	0.0	0.1	0.4	0.8	0.8	0.8	0.9	0.4	0.4	0.5	0.5	14.3 osig	5.3 osig
	Available Upstream Control Valve DP	psi													
	Segment Upstream pressure	psig	0.00	0.15	0.36	0.45	0.45	0.83	0.90	0.38	0.38	0.50	0.52		
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Other Pressure Drop (Equip & Allow)	psi	#VALUE!	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Friction Pressure Drop	psi	0.11	0.06	0.21	0.09	0.00	0.37	0.07	0.02	0.00	0.12	0.02		
	Acceleration Factor		1.57E-02	3.01E-03	1.17E-02	5.47E-03	2.52E-05	5.30E-03	1.26E-03	1.10E-03	5.10E-06	1.09E-03	4.81E-04		
	Total System Pressure Drop	psi	#VALUE!	0.15	0.21	0.09	0.00	0.37	0.07	0.02	0.00	0.12	0.02		
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.15	0.36	0.45	0.45	0.83	0.36	0.38	0.38	0.50		
	Available Downstream Control Valve DP	psi													
	Pressure after Control Valve	psig	0.0000	0.0000	0.1488	0.3628	0.4543	0.4543	0.8252	0.3628	0.3787	0.3787	0.4961		
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK		
		V[Mscfd]	792	792	1,584	1,094	1,094	1,094	547	490	490	490	327		
		V[scfh AIR]	33,082	33,082	66,163	45,706	45,706	45,706	22,853	20,458	20,458	20,458	13,636		

Veronica USA Pad

HALKER
C O N S U L T I N G

7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

LENA FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	Tim Archuleta	
CC:	Nate Mascarenas, Kendra Meeker	
DATE:	July 19, 2017	
RE:	Lena Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Lena facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D piping model (dated 6/13/17) of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.49 psig (7.8 oz/in^{2}g).

During normal operating conditions the 7.8 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 49% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.72 oz/in^2 and is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 551 Mscfd, and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary.

Using the same calculation methodology, the total gas flow rate can be increased to 765 Mscfd and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.39 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

	Hydraulic Calculations										
Client	Marathon Oil	Basis / Notes -->									
Project	TVCS Ventline										
Location	Lena Facility (Within Veronica)										
Unit			4" atm flare tip	6" After KO	KO	6" full flow to KO	6" Half of tanks	4" Half of tanks			
Proj #	16039-06	Atm Pres 13.46									
By/Chk'd	DJF	Pres Unit psia									
Rev/Date	19-Jul-17	SEGMENT ID	G	H	I	J	K	L			
Pressure Data	Upstream Segment ID or known press.	psia									
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d			
Fric Method	(1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=isothermal)										
Holdup Meth	(blank=default,2 =Hughmark,3=L-M,4=B&B,5=Eaton)										
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	inches	4.000	6.000	24.000	6.000	6.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std			
	Straight pipe length	ft	20.0	101.2	8.0	506.6	14.9	61.0			
Elevation	Inlet & Outlet — Inlet	ft									
	OR — Outlet	ft									
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0			
3K Method	90's — Std (R/D=1), threaded										
	Short Radius (R/D=1), flgd/welded										
	90's — Standard (R/D=1.5), all types		1	2		3		3			
	Mitered — 1 weld (90 deg angle)										
	2 weld (45 deg angle)										
	3 weld (30 deg angle)										
Elbows	Choose type: Plug Valve Branch Flow										
	Choose type: Plug Valve Straight Thru										
	45's — Short Radius (R/D=1), all types										
	45's — Standard (R/D=1.5), all types					2					
	Mitered, 1 weld, 45 deg angle										
	Mitered, 2 weld, 22.5 deg angle										
	Choose type: Ball Valve Full Port										
	180's — Close Return (R/D=1), threaded										
	Close Return (R/D=1), flgd/welded										
	180 — Standard (R/D=1.5), all types										
Tees	Used as an Elbow — Standard (R/D=1), threaded										
	Long-radius (R/D=1.5), threaded										
	Standard (R/D=1), flanged or welded					1	1	1			
	Stub-in type branch										
	Flow-thru Tee — Threaded										
	Flanged or Welded			1		2		3			
	Stub-in type branch										
Valves	Gate, Ball or Plug — Full line size, Beta=1.0			1		1		1			
	Reduced trim, Beta=0.9										
	Reduced trim, Beta=0.8										
	Globe, standard										
	Globe - (Angle or Y-type) or Diaphragm (dam type)										
	Butterfly										
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5										
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5							1			
	Tilting-disk										
Other DP	Pipe Entrance/Exit?(0=none,1=entr.,2=exit,3=both)			1		2					
	Swage to Diameter (at end)	in		4.000				6.000			
	Orifice Diameter	in									
	Initial Swage from Diameter	in									
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.045							
	Other Head Pressure Drop (Equip, etc.)	ft fluid									
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5									
	Miscellaneous Flow Resistance	K factor									
Liquid	Flow (provide mass OR volume basis)	lb/hr									
		gpm									
	Density	lb/ft3									
	Viscosity	cP									
	Surface Tension (2 phase only)	dyne/cm									
Vapor	Flow Rate	lb/hr	1,763	1,763	1,763	1,763	882	882			
	Density OR MW, Z & T — Density	lb/ft3									
	MW		29.14	29.14	29.14	29.14	29.14	29.14			
	Z		0.994	0.994	0.994	0.994	0.994	0.994			
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	6.065	23.250	6.065	6.065	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	1763	1763	1763	1763	882	882			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.04	0.12	0.17	0.28	0.38	0.44			
	Vapor Density (Avg)	lb/ft3	0.0641	0.0645	0.0648	0.0653	0.0658	0.0660			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.07	0.07	0.07			
	Pipe Flow Area	ft2	0.0884	0.2006	2.9483	0.2006	0.2006	0.0884			
	Bulk Velocity	ft/sec	86.39	37.83	2.56	37.40	18.55	41.95			
	Erosional Velocity if solids present	ft/sec	394.86	393.63	392.91	391.39	389.86	389.12			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		2.71E+05	1.80E+05	4.69E+04	1.80E+05	8.99E+04	1.35E+05			
	Friction Factor f (Colebrook & White)		0.0181	0.0179	0.0215	0.0179	0.0198	0.0193			
Friction	K (straight pipe)		1.08	3.59	0.09	17.97	0.58	3.52			
	K (fittings + valves)		0.27	0.81	0.00	2.51	0.94	4.23			
	K (entrance + exit + swages + orifice)		0.00	1.04	0.00	1.01	0.00	0.31			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00			
	Total K		1.35	5.44	0.09	21.50	1.52	8.06			
	Velocity Head (Average Density Basis)	ft fluid	115.97	22.24	0.10	21.74	5.35	27.34			
	Equivalent length	ft	25.0	153.3	8.0	606.1	38.9	139.7			
TOTAL	Upstream Pressure before CV	psig	0.0701	0.1697	0.1697	0.38183	0.38556	0.487	<=	7.8 49%	oz.in2
	Available Upstream Control Valve DP	psi									
	Segment Upstream pressure	psig	0.07	0.17	0.17	0.38	0.39	0.49			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.05	0.00	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.07	0.05	0.00	0.21	0.00	0.10			
	Acceleration Factor		7.66E-03	1.47E-03	6.75E-06	1.43E-03	3.53E-04	1.80E-03			
	Total System Pressure Drop	psi	0.07	0.10	0.00	0.21	0.00	0.10			
	Segment Downstream Pres., before C.V.	psig	0.00	0.07	0.17	0.17	0.38	0.39			
	Available Downstream Control Valve DP	psi									
	Pressure after Control Valve	psig	0.0000	0.0701	0.1697	0.1697	0.3818	0.3856			
	Error Status		OK	OK	OK	OK	OK	OK			
		V [MscfD]	551	551	551	551	275.5	275.5			
		V [scfhair]	23,014								

HALKER
CONSULTING

7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

VERONICA FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	John Van Pelt	
CC:	Tim Archuleta, Nate Mascarenas, Kendra Meeker	
DATE:	June 12, 2017	
RE:	Veronica Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Veronica facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.72 psig (11.5 oz/in^{2}g).

During normal operating conditions the 11.5 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 72% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in² was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 1.45 oz/in² and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 328 mscfd (1049 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to 371 MSCFD (1187 lb/hr) and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in²). This is approximately 1.13 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

Hydraulic Calculations

Client:	Marathon Oil	Basis / Notes -->
Project:	TVCS Ventline	
Location:	Veronica Facility	
Unit:		
Proj #:	16039-06	Atm Pres 13.46
By/Chk'd:	JVP	Pres Unit psia
Rev/Date:	6-Jun-17	

Section	Item	Unit	7	6	5	4	3	2	1	<= segment		
			4" atm flare tip	4" After KO	6" Outlet of KO	KO	6" Before KO Drum	4" full flow to KO	4" Half of tanks			
	SEGMENT ID		G	H	I	J	K	L	M			
Pressure Data	Upstream Segment ID or known press.	psia										
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k	l			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d			
Fric Method	(Hmixing 2=Dukler-Dukler, 3=L-M, 4=Begg-Brill, 5=Isothermal)											
Holdup Meth	(blank=default,2 =Hughmark,3=L-M,4=B&B,5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	inches	4.000	4.000	6.000	24.000	6.000	4.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std			
	Straight pipe length	ft		166.6	7.8	8.0	7.8	301.9	196.4			
Elevation	Inlet & Outlet OR	Inlet ft										
		Outlet ft										
	Difference (Outlet - Inlet)	Difference ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
3K Method	90's Std (R/D=1), threaded											
	Short Radius (R/D=1), flgd/welded											
	90's Standard (R/D=1.5), all types				2			5	2			
	Mitered 1 weld (90 deg angle)											
	Mitered 2 weld (45 deg angle)											
	Mitered 3 weld (30 deg angle)											
Elbows	Choose type Plug Valve Branch Flow											
	Choose type Plug Valve Straight Thru											
	45's Short Radius (R/D=1), all types											
	45's Standard (R/D=1.5), all types											
	Mitered, 1 weld, 45 deg angle											
	Mitered, 2 weld, 22.5 deg angle											
	Choose type Ball Valve Full Port											
	Close Return (R/D=1), threaded											
	180's Close Return (R/D=1), flgd/welded											
	180 Standard (R/D=1.5), all types											
Tees	Used as an Elbow: Standard (R/D=1), threaded											
	Long-radius (R/D=1.5), threaded											
	Standard (R/D=1), flanged or welded							1	2			
	Stub-in type branch											
	Flow-thru Tee: Threaded											
	Flanged or Welded				1			2	11			
	Stub-in type branch											
Valves	Gate, Ball or Plug: Full line size, Beta=1.0						1		1			
	Reduced trim, Beta=0.9											
	Reduced trim, Beta=0.8											
	Globe, standard											
	Globe - (Angle or Y-type) or Diaphragm (dam type)											
	Butterfly											
	Check: Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5											
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1			
	Tilting-disk											
Other DP	Pipe Entrance/Exit?(0=none,1=entr., 2=exit,3=both)				1		2		1			
	Swage to Diameter (at end)	in			4.000			6.000				
	Orifice Diameter	in										
	Initial Swage from Diameter	in										
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.091								
	Other Head Pressure Drop (Equip, etc.)	ft fluid										
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5										
	Miscellaneous Flow Resistance	K factor										
Liquid	Flow (provide mass OR volume basis)	lb/hr										
		gpm										
	Density	lb/ft3										
	Viscosity	cP										
	Surface Tension (2 phase only)	dyne/cm										
Vapor	Flow Rate	lb/hr	1049.42	1049.42	1049.42	1049.42	1049.42	1049.42	524.71			
	Density OR MW, Z & T	Density lb/ft3										
		MW	29.14	29.14	29.14	29.14	29.14	29.14	29.14			
		Z	0.994	0.994	0.994	0.994	0.994	0.994	0.994			
		Temp F	115.0	115.0	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	4.026	6.065	23.250	6.065	4.026	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	1049	1049	1049	1049	1049	1049	525			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.13	0.27	0.27	0.27	0.45	0.67			
	Vapor Density (Avg)	lb/ft3	0.0640	0.0646	0.0652	0.0652	0.0653	0.0661	0.0672			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.07	0.07	0.07	0.07	0.07			
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884			
	Bulk Velocity	ft/sec	51.55	51.05	22.27	1.52	22.26	49.87	24.54			
	Erosional Velocity if solids present	ft/sec	395.38	393.46	391.53	391.48	391.44	388.88	385.83			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		1.61E+05	1.61E+05	1.07E+05	2.79E+04	1.07E+05	1.61E+05	8.06E+04			
	Friction Factor f (Colebrook & White)		0.0190	0.0190	0.0193	0.0241	0.0193	0.0190	0.0207			
Friction	K (straight pipe)		0.00	9.42	0.30	0.10	0.30	17.06	12.14			
	K (fittings + valves)		0.00	0.00	0.67	0.00	0.15	2.75	6.48			
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.02	0.31	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Total K		0.00	9.42	2.01	0.10	1.46	20.12	19.23			
	Velocity Head (Average Density Basis)	ft fluid	41.29	40.50	7.71	0.04	7.70	38.64	9.36			
	Equivalent length	ft	0.0	166.6	52.7	8.0	38.3	355.9	311.1			
TOTAL	Upstream Pressure before CV	psig	0.0000	0.2622	0.2692	0.2692	0.27430	0.63224	0.716	<=	11.5	oz.in2
	Available Upstream Control Valve DP	psi										
	Segment Upstream pressure	psig	0.00	0.26	0.27	0.27	0.27	0.63	0.72			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.09	0.00	0.00	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.17	0.01	0.00	0.01	0.36	0.08			
	Acceleration Factor		2.73E-03	2.67E-03	5.09E-04	2.36E-06	5.08E-04	2.55E-03	6.18E-04			
	Total System Pressure Drop	psi	0.00	0.26	0.01	0.00	0.01	0.36	0.08			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.26	0.27	0.27	0.27	0.63			
	Available Downstream Control Valve DP	psi										
	Pressure after Control Valve	psig	0.0000	0.0000	0.2622	0.2692	0.2692	0.2743	0.6322			
	Error Status		OK	OK	OK	OK	OK	OK	OK			

Sherman USA Pad

SHERMAN USA CTB VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil
FROM:	Tim Archuleta
CC:	Nate Mascarenas, Kendra Meeker
DATE:	July 12, 2017
RE:	Sherman USA CTB - Vent Line Design and Capacity Assessment

(b) (6) [redacted]

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Sherman USA CTB vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2, will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the vent system 3D model (dated 7-10-2017) and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of 13.5 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.52 psig (8.3 oz/in^2g).

During normal operating conditions the 8.3 oz/in^2g pressure should be the highest pressure that the tanks will see and is 52% of the of 16 oz/in^2g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.34 oz/in^2 and is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 345 Mscfd (1,103 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 462 Mscfd (1,480 lb/hr) and stay at or below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.3 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1 - Normal Flow Hydraulic Calculations

Hydraulic Calculations

Client:	Marathon Oil	Basis /									
Project:	Sherman Facility	Notes -->	8	7	6	5	4	3	2	1	<= segment
Location:											
Unit:	TVCS Normal Flow Calculations		4"	6"	4"	6"	24"	6"	4"	4"	
Proj #:	Atm Pres	13.5	atm	Outlet of KO	Outlet of KO	Outlet of KO	KO	Upstream	Upstream	Half of	
By/Chk'd:	Pres Unit	psia	flare tip				Drum	of KO	of KO	tanks	
Rev/Date:	12-Jul-17	SEGMENT ID	G	H	I	J	K	L	M	N	
Pressure Data	Upstream Segment ID or known press.	psia									
	Downstream Segment ID or known press	psia	13.50	G	H	I	J	K	L	M	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	
Fric Method (1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=Isothermal)											
Holdup Meth (blank=default, 2=Hughmark, 3=L-M, 4=B&B, 5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Nominal Line Size or Internal Diameter	Inches	4.000	6.000	4.000	6.000	24.000	6.000	4.000	4.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	
	Straight pipe length	ft	15.0	128.0	1.0	5.0	8.0	10.0	287.0	148.0	
Elevation	Inlet & Outlet OR / Inlet	ft									
	Outlet	ft									
	Difference (Outlet - Inlet) / Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's Std (R/D=1), threaded										
	90's Short Radius (R/D=1), flgd/welded										
	90's Standard (R/D=1.5), all types			2		1		1	1	3	
	Mitered 1 weld (90 deg angle)										
	Mitered 2 weld (45 deg angle)										
	Mitered 3 weld (30 deg angle)										
Elbows	Choose type Plug Valve Branch Flow										
	Choose type Plug Valve Straight Thru										
	45's Short Radius (R/D=1), all types										
	45's Standard (R/D=1.5), all types			1					1		
	Mitered, 1 weld, 45 deg angle										
	Mitered, 2 weld, 22.5 deg angle										
	Choose type Ball Valve Full Port										
	180's Close Return (R/D=1), threaded										
	180's Close Return (R/D=1), flgd/welded										
	180 Standard (R/D=1.5), all types										
Tees	Used as an Elbow Standard (R/D=1), threaded										
	Used as an Elbow Long-radius (R/D=1.5), threaded										
	Used as an Elbow Standard (R/D=1), flanged or welded								1	2	
	Used as an Elbow Stub-in type branch										
	Flow-thru Tee Threaded										
	Flow-thru Tee Flanged or Welded			1					1	6	
	Flow-thru Tee Stub-in type branch										
Valves	Gate, Ball or Plug Full line size, Beta=1.0			1	1				1	1	
	Gate, Ball or Plug Reduced trim, Beta=0.9										
	Gate, Ball or Plug Reduced trim, Beta=0.8										
	Globe, standard										
	Globe - (Angle or Y-type) or Diaphragm (dam type)										
	Butterfly										
	Check Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5										
	Check Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5									1	
	Check Tilting-disk										
Other DP	Pipe Entrance/Exit? (0=none, 1=enb., 2=exit, 3=both)							1		1	
	Swage to Diameter (at end)	in		4.000	6.000	4.000	6.000		6.000		
	Orifice Diameter	in									
	Initial Swage from Diameter	in									
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.021							
	Other Head Pressure Drop (Equip, etc.)	ft fluid									
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5									
	Miscellaneous Flow Resistance	K factor									
Liquid	Flow (provide mass OR volume basis)	lb/hr									
		gpm									
	Density	lb/ft3									
	Viscosity	cP									
	Surface Tension (2 phase only)	dyne/cm									
Vapor	Flow Rate	lb/hr	1104.08	1104.08	1104.08	1104.08	1104.08	1104.08	1104.08	552.04	
	Density OR MW, Z & T — Density	lb/ft3									
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	6.065	4.026	6.065	23.250	6.065	4.026	4.026	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	1104	1104	1104	1104	1104	1104	1104	552	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.01	0.04	0.07	0.07	0.08	0.08	0.26	0.48	
	Vapor Density (Avg)	lb/ft3	0.0642	0.0644	0.0645	0.0645	0.0645	0.0646	0.0654	0.0665	
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884	
	Bulk Velocity	ft/sec	54.02	23.75	53.79	23.69	1.61	23.68	53.03	26.10	
	Erosional Velocity if solids present	ft/sec	394.63	394.17	393.76	393.66	393.63	393.60	390.96	387.88	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		1.73E+05	1.15E+05	1.73E+05	1.15E+05	3.00E+04	1.15E+05	1.73E+05	8.66E+04	
	Friction Factor f (Colebrook & White)		0.0188	0.0190	0.0188	0.0190	0.0237	0.0190	0.0188	0.0205	
Friction	K (straight pipe)		0.84	4.82	0.06	0.19	0.10	0.38	16.10	9.05	
	K (fittings + valves)		0.00	0.99	0.16	0.25	0.00	0.25	1.83	5.83	
	K (entrance + exit + swages + orifice)		0.00	0.43	0.31	0.43	22.82	0.61	0.31	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		0.84	6.25	0.52	0.87	22.92	1.24	18.23	15.49	
	Velocity Head (Average Density Basis)	ft fluid	45.36	8.77	44.96	8.72	0.04	8.72	43.70	10.58	
	Equivalent length	ft	15.0	165.8	9.3	23.1	1874.1	32.8	325.0	253.3	
TOTAL	Upstream Pressure before CV	psig	0.0171	0.0626	0.0731	0.0765	0.07691	0.08172	0.44464	0.52	0.3 psig
	Available Upstream Control Valve DP	psi									
	Segment Upstream pressure	psig	0.02	0.06	0.07	0.08	0.08	0.08	0.44	0.52	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.02	0.02	0.01	0.00	0.00	0.00	0.36	0.08	
	Acceleration Factor		2.99E-03	5.79E-04	2.97E-03	5.76E-04	2.67E-06	5.75E-04	2.88E-03	6.99E-04	
	Total System Pressure Drop	psi	0.02	0.05	0.01	0.00	0.00	0.00	0.36	0.08	
	Segment Downstream Pres., before C.V.	psig	0.00	0.02	0.06	0.07	0.08	0.08	0.08	0.44	
	Available Downstream Control Valve DP	psi									
	Pressure after Control Valve	psig	0.0000	0.0171	0.0626	0.0731	0.0765	0.0769	0.0817	0.4446	
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	
		V [Mscfd]	345	345	345	345	345	345	345	173	
		V [scfhAIR]	14,410								

Attachment 2 - Maximum Flow Hydraulic Calculations

Hydraulic Calculations

Client:	Marathon Oil	Basis / Notes -->	
Project:	Sherman Facility		
Location:			
Unit:	TVCS Maximum Flow Calculations		
Proj #:		Atm Pres	13.5
By/Chk'd:		Pres Unit	psia
Rev/Date:	12-Jul-17		

Section	Item	Unit									
			8	7	6	5	4	3	2	1	<= segment
			4" atm flare tip	6" Outlet of KO	4" Outlet of KO	6" Outlet of KO	24" KO Drum	6" Upstream of KO	4" Upstream of KO	4" Half of tanks	
	SEGMENT ID		G	H	I	J	K	L	M	N	
Pressure Data	Upstream Segment ID or known press.	psia									
	Downstream Segment ID or known press	psia	13.50	G	H	I	J	K	L	M	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	
Fric Method (1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=isothermal)											
Holdup Meth (blank=default, 2 =Hughmark, 3=L-M, 4=B&B, 5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Nominal Line Size or Internal Diameter	inches	4.000	6.000	4.000	6.000	24.000	6.000	4.000	4.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	
	Straight pipe length	ft	15.0	126.0	1.0	5.0	8.0	10.0	287.0	148.0	
Elevation	Inlet & Outlet OR — Inlet	ft									
	Outlet	ft									
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's Std (R/D=1), threaded										
	90's Short Radius (R/D=1), flgd/welded										
	90's Standard (R/D=1.5), all types			2		1		1	1	3	
	Mitered 1 weld (90 deg angle)										
	Mitered 2 weld (45 deg angle)										
	Mitered 3 weld (30 deg angle)										
	Choose type: Plug Valve Branch Flow										
	Choose type: Plug Valve Straight Thru										
Elbows	45's Short Radius (R/D=1), all types										
	45's Standard (R/D=1.5), all types			1					1		
	Mitered, 1 weld, 45 deg angle										
	Mitered, 2 weld, 22.5 deg angle										
	Choose type: Ball Valve Full Port										
	180's Close Return (R/D=1), threaded										
	180's Close Return (R/D=1), flgd/welded										
	180 Standard (R/D=1.5), all types										
Tees	Used as an Elbow: Standard (R/D=1), threaded										
	Long-radius (R/D=1.5), threaded										
	Standard (R/D=1), flanged or welded								1	2	
	Stub-in type branch										
	Flow-thru Tee: Threaded										
	Flanged or Welded			1					1	6	
	Stub-in type branch										
Valves	Gate, Ball or Plug: Full line size, Beta=1.0			1	1				1	1	
	Reduced trim, Beta=0.9										
	Reduced trim, Beta=0.8										
	Globe, standard										
	Globe - (Angle or Y-type) or Diaphragm (dam type)										
	Butterfly										
	Check: Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5										
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5									1	
	Tilting-disk										
Other DP	Pipe Entrance/Exit? (0=none, 1=entr., 2=exit, 3=both)							1		1	
	Swage to Diameter (at end)	in		4.000	6.000	4.000	6.000		6.000		
	Orifice Diameter	in									
	Initial Swage from Diameter	in									
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.034							
	Other Head Pressure Drop (Equip, etc.)	ft fluid									
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5									
	Miscellaneous Flow Resistance	K factor									
Liquid	Flow (provide mass OR volume basis)	lb/hr									
		gpm									
	Density	lb/ft3									
	Viscosity	cP									
	Surface Tension (2 phase only)	dyne/cm									
Vapor	Flow Rate	lb/hr	1478.51	1478.51	1478.51	1478.51	1478.51	1478.51	1478.51	739.25	
	Density OR MW, Z & T — Density	lb/ft3									
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	6.065	4.026	6.065	23.250	6.065	4.026	4.026	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	1479	1479	1479	1479	1479	1479	1479	739	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.01	0.07	0.12	0.13	0.13	0.14	0.45	0.83	
	Vapor Density (Avg)	lb/ft3	0.0642	0.0645	0.0647	0.0648	0.0648	0.0648	0.0663	0.0681	
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.2006	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884	
	Bulk Velocity	ft/sec	72.31	31.74	71.78	31.60	2.15	31.58	70.04	34.09	
	Erosional Velocity if solids present	ft/sec	394.53	393.76	393.07	392.89	392.85	392.76	388.28	383.12	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		2.32E+05	1.54E+05	2.32E+05	1.54E+05	4.02E+04	1.54E+05	2.32E+05	1.16E+05	
	Friction Factor f (Colebrook & White)		0.0183	0.0183	0.0183	0.0183	0.0222	0.0183	0.0183	0.0197	
Friction	K (straight pipe)		0.82	4.63	0.05	0.18	0.09	0.36	15.65	8.70	
	K (fittings + valves)		0.00	0.99	0.16	0.25	0.00	0.25	1.82	5.81	
	K (entrance + exit + swages + orifice)		0.00	0.43	0.31	0.43	22.73	0.61	0.31	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		0.82	6.05	0.52	0.86	22.82	1.22	17.78	15.12	
	Velocity Head (Average Density Basis)	ft fluid	81.26	15.66	80.07	15.52	0.07	15.50	76.23	18.06	
	Equivalent length	ft	15.0	167.2	9.5	23.8	1991.9	33.7	326.1	257.3	
TOTAL	Upstream Pressure before CV	psig	0.0298	0.1061	0.1249	0.1309	0.13161	0.14014	0.76747	0.90	14.3 psig
	Available Upstream Control Valve DP	psi									
	Segment Upstream pressure	psig	0.03	0.11	0.12	0.13	0.13	0.14	0.77	0.90	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.03	0.04	0.02	0.01	0.00	0.01	0.62	0.13	
	Acceleration Factor		5.37E-03	1.03E-03	5.29E-03	1.02E-03	4.74E-06	1.02E-03	5.03E-03	1.19E-03	
	Total System Pressure Drop	psi	0.03	0.08	0.02	0.01	0.00	0.01	0.63	0.13	
	Segment Downstream Pres., before C.V.	psig	0.00	0.03	0.11	0.12	0.13	0.13	0.14	0.77	
	Available Downstream Control Valve DP	psi									
	Pressure after Control Valve	psig	0.0000	0.0298	0.1061	0.1249	0.1309	0.1316	0.1401	0.7675	
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	
		V[Mscfd]	462	462	462	462	462	462	462	231	
		V[scfhAIR]	19.296								

Chapman CTB

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7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

Chapman Facility Tank Battery Vent Line Design & Capacity Assessment

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	Tim Archuleta	
CC:	Nate Mascarenas, Kendra Meeker	
DATE:	June 22, 2017	
RE:	Chapman Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Chapman facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of 13.5 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.57 psig (9.2 oz/in^{2}g).

During normal operating conditions the 9.2 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 57% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in² was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 1.3 oz/in² and is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 789 mscfd (2,525 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 1.1 mmscfd (3,680 lb/hr) and stay at or below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in²). This is approximately 1.5 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

Hydraulic Calculations

Client:	Marathon Oil	Basis / Notes -->								
Project:	TVCS Ventline									
Location:	Chapman Facility									
Unit:				6"	36"	6"	6"			
Proj #:	16039-10	Atm Pres 13.45	atm	Outlet of KO	KO	full flow	Half of			
By/Chk'd:	TMA	Pres Unit psia	flare tip		Drum	to KO	tanks			
Rev/Date:	22-Jun-17	SEGMENT ID	G	H	I	J	K			

Section	Item	Unit	G	H	I	J	K			
Pressure Data	Upstream Segment ID or known press.	psia								
	Downstream Segment ID or known press.	psia	13.46	g	h	i	j			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d			
Fric Method	(1=Homog, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=isothermal)									
Holdup Meth	(blank=default, 2 =Hughmark, 3=L-M, 4=B&B, 5=Eaton)									
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	Inches	6.000	6.000	36.000	6.000	6.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std		std	std			
	Straight pipe length	ft	1.0	129.0	8.0	205.5	130.5			
Elevation	Inlet & Outlet — Inlet	ft								
	OR — Outlet	ft								
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0			
3K Method	90's — Std (R/D=1), threaded									
	Short Radius (R/D=1), flgd/welded									
	90's — Standard (R/D=1.5), all types			2		2	2			
	Mitered — 1 weld (90 deg angle)									
	Mitered — 2 weld (45 deg angle)									
	Mitered — 3 weld (30 deg angle)									
Elbows	Choose type — Plug Valve Branch Flow									
	Choose type — Plug Valve Straight Thru									
	45's — Short Radius (R/D=1), all types									
	45's — Standard (R/D=1.5), all types									
	Mitered, 1 weld, 45 deg angle									
	Mitered, 2 weld, 22.5 deg angle									
	Choose type — Ball Valve Full Port									
	Close Return (R/D=1), threaded									
	180's — Close Return (R/D=1), flgd/welded									
	180 — Standard (R/D=1.5), all types									
Tees	Used as an Elbow — Standard (R/D=1), threaded									
	Long-radius (R/D=1.5), threaded									
	Standard (R/D=1), flanged or welded						1			
	Stub-in type branch									
	Flow-thru Tee — Threaded									
	Flanged or Welded						8			
	Stub-in type branch									
Valves	Gate, Ball or Plug — Full line size, Beta=1.0			1		1	1			
	Reduced trim, Beta=0.9									
	Reduced trim, Beta=0.8									
	Globe, standard									
	Globe - (Angle or Y-type) or Diaphragm (dam type)									
	Butterfly									
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5									
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5						1			
	Tilting-disk									
Other DP	Pipe Entrance/Exit?(0=none,1=entr., 2=exit,3=both)			1		2	1			
	Swage to Diameter (at end)	in		4.026						
	Orifice Diameter	in								
	Initial Swage from Diameter	in								
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.083						
	Other Head Pressure Drop (Equip, etc.)	ft fluid								
	Valve Cv (Non-flashing liquid only!)	gpm/psi^.5								
	Miscellaneous Flow Resistance	K factor								
Liquid	Flow (provide mass OR volume basis)	lb/hr								
		gpm								
	Density	lb/ft3								
	Viscosity	cP								
	Surface Tension (2 phase only)	dyne/cm								
Vapor	Flow Rate	lb/hr	2525.00	2525.00	2525.00	2525.00	2525.00			
	Density OR MW, Z & T — Density	lb/ft3								
	MW		29.14	29.14	29.14	29.14	29.14			
	Z		0.994	0.994	0.994	0.994	0.994			
	Temp	F	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	6.065	6.065	36.000	6.065	6.065			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	2525	2525	2525	2525	2525			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.10	0.21	0.30	0.48			
	Vapor Density (Avg)	lb/ft3	0.0640	0.0645	0.0650	0.0654	0.0662			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.07	0.07			
	Pipe Flow Area	ft2	0.2006	0.2006	7.0686	0.2006	0.2006			
	Bulk Velocity	ft/sec	54.65	54.23	1.53	53.48	52.78			
	Erosional Velocity if solids present	ft/sec	395.37	393.86	392.36	391.11	388.55			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		2.57E+05	2.57E+05	4.34E+04	2.57E+05	2.57E+05			
	Friction Factor f (Colebrook & White)		0.0172	0.0172	0.0217	0.0172	0.0172			
Friction	K (straight pipe)		0.03	4.39	0.06	7.00	4.44			
	K (fittings + valves)		0.00	0.64	0.00	0.64	4.45			
	K (entrance + exit + swages + orifice)		0.00	1.02	0.00	1.01	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00			
	Total K		0.03	6.06	0.06	8.65	9.50			
	Velocity Head (Average Density Basis)	ft fluid	46.41	45.70	0.04	44.44	43.29			
	Equivalent length	ft	1.0	177.8	8.0	254.0	279.0			
TOTAL	Upstream Pressure before CV	psig	0.0007	0.2075	0.20751	0.38260	0.57234	<=	9.16	oz.in2
	Available Upstream Control Valve DP	psi								
	Segment Upstream pressure	psig	0.00	0.21	0.21	0.38	0.57			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.08	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.12	0.00	0.17	0.19			
	Acceleration Factor		3.06E-03	3.02E-03	2.39E-06	2.93E-03	2.86E-03			
	Total System Pressure Drop	psi	0.00	0.21	0.00	0.18	0.19			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.21	0.21	0.38			
	Available Downstream Control Valve DP	psi								
	Pressure after Control Valve	psig	0.0000	0.0007	0.2075	0.2075	0.3826			
	Error Status		OK	OK	OK	OK	OK			

Big Head Pad (Stark CTB)

HALKER
CONSULTING

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Centennial, CO 80112
303-515-2700

STARK FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	Tim Archuleta	
CC:	Kendra Meeker, Nate Mascarenas	
DATE:	September 12, 2017	
RE:	Stark Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Stark facility tank battery vent line design to ensure that the thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model (dated 7.20.2017) of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.4 psig (6.5 oz/in^{2}g).

During normal operating conditions the 6.5 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 40% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 0.8 oz/in^2 and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 265 Mscfd (848 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 405 Mscfd (1,296 lb/hr) and stay at or below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.5 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Normal Flow Hydraulic Calculations

	Hydraulic Calculations									
Client:	Marathon Oil	Basis / Notes -->	7	6	5	4	3	2	1	<= segment
Project: Location: Unit: Proj #:	Normal Flowrate	Atm Pres 13.46	4" atm flare tip	4" After KO	6" Outlet of KO	KO	6" Before KO Drum	4" Lift flow to KO	4" Half of tanks	
By/Chk'd:	DJF	Pres Unit psia								
Rev/Date:	A 12-Sep-17	SEGMENT ID	G	H	I	J	K	L	M	
Pressure Data	Upstream Segment ID or known press.	psia								
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k	l	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	
Fric Method (1=Homog, 2 or blank=Dukler, 3=L-M, 4=Beggs-Brill, 5=isothermal)										
Holdup Meth (blank=default, 2 =Hughmark, 3=L-M, 4=B&B, 5=Eaton)										
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00021	
	Nominal Line Size or internal Diameter	inches	4.000	4.000	6.000	24.000	6.000	4.000	4.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	
	Straight pipe length	ft	20.0	142.0	6.0	8.0	14.0	201.5	188.5	552 ft total
Elevation	Inlet & Outlet OR	Inlet ft								
		Outlet ft								
	Difference (Outlet - Inlet)	Difference ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's Std (R/D=1), threaded									
	90's Short Radius (R/D=1), flgd/welded									
	90's Standard (R/D=1.5), all types			3	1		1		2	
	Mitered 1 weld (90 deg angle)									
	Mitered 2 weld (45 deg angle)									
	Mitered 3 weld (30 deg angle)									
	Choose type Plug Valve Branch Flow									
	Choose type Plug Valve Straight Thru									
Elbows	45's Short Radius (R/D=1), all types									
	45's Standard (R/D=1.5), all types									
	Mitered, 1 weld, 45 deg angle									
	Mitered, 2 weld, 22.5 deg angle									
	Choose type Ball Valve Full Port									
	180's Close Return (R/D=1), threaded									
	180's Close Return (R/D=1), flgd/welded									
	180 Standard (R/D=1.5), all types									
Tees	Used as an Elbow: Standard (R/D=1), threaded									
	Used as an Elbow: Long-radius (R/D=1.5), threaded									
	Used as an Elbow: Standard (R/D=1), flanged or welded							2	2	
	Used as an Elbow: Stub-in type branch									
	Flow-thru Tee: Threaded									
	Flow-thru Tee: Flanged or Welded							1	10	
	Flow-thru Tee: Stub-in type branch									
Valves	Gate, Ball or Plug: Full line size, Beta=1.0				1		1		1	
	Gate, Ball or Plug: Reduced trim, Beta=0.9									
	Gate, Ball or Plug: Reduced trim, Beta=0.8									
	Globe, standard									
	Globe - (Angle or Y-type) or Diaphragm (dam type)									
	Butterfly									
	Check: Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5									
	Check: Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1	
	Check: Tilting-disk									
Other DP	Pipe Entrance/Exit?(0=none,1=entr., 2=exit,3=both)				1		2		1	
	Swage to Diameter (at end)	in			4.000			6.000		
	Orifice Diameter	in								
	Initial Swage from Diameter	in								
	Other Pressure Drop (Equip, etc.)	psi		0.050						8 psig dP through 4-inch Series 8
	Other Head Pressure Drop (Equip, etc.)	ft fluid								
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5								
	Miscellaneous Flow Resistance	K factor								
Liquid	Flow (provide mass OR volume basis)	lb/hr								
		gpm								
	Density	lb/ft3								
	Viscosity	cP								
	Surface Tension (2 phase only)	dyne/cm								
Vapor	Flow Rate	lb/hr	848	848	848	848	848	848	424	
	Density OR MW, Z & T: Density	lb/ft3								
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	4.026	6.065	23.250	6.065	4.026	4.026	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flowrate	lb/hr	0	0	0	0	0	0	0	
	Flowrate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	848	848	848	848	848	848	424	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.01	0.09	0.17	0.18	0.18	0.26	0.38	
	Vapor Density (Avg)	lb/ft3	0.0640	0.0644	0.0648	0.0648	0.0648	0.0652	0.0658	
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.06	0.06	0.06	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884	
	Bulk Velocity	ft/sec	41.63	41.37	18.12	1.23	18.12	40.85	20.26	
	Erosional Velocity if solids present	ft/sec	395.27	394.02	392.85	392.82	392.79	391.56	389.97	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		1.30E+05	1.30E+05	8.64E+04	2.25E+04	8.64E+04	1.30E+05	6.51E+04	
	Friction Factor f (Colebrook & White)		0.0194	0.0194	0.0199	0.0253	0.0199	0.0194	0.0220	
Friction	K (straight pipe)		1.16	8.23	0.24	0.10	0.55	11.67	12.38	
	K (fittings + valves)		0.00	0.82	0.40	0.00	0.40	2.23	6.31	
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.02	0.31	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		1.16	9.05	1.68	0.10	1.97	14.21	19.31	
	Velocity Head (Average Density Basis)	ft fluid	26.94	26.60	5.10	0.02	5.10	25.94	6.38	
	Equivalent length	ft	20.0	156.2	42.6	8.0	49.9	245.3	293.9	
TOTAL	Upstream Pressure before CV	psig	0.0139	0.1719	0.17576	0.17576	0.18028	0.34782	0.40380	6.5 osig
	Available Upstream Control Valve DP	psi								
	Segment Upstream pressure	psig	0.01	0.17	0.18	0.18	0.18	0.35	0.40	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.05	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.01	0.11	0.00	0.00	0.00	0.17	0.06	
	Acceleration Factor		1.78E-03	1.76E-03	3.37E-04	1.56E-06	3.37E-04	1.71E-03	4.21E-04	
	Total System Pressure Drop	psi	0.01	0.16	0.00	0.00	0.00	0.17	0.06	
	Segment Downstream Pres., before C.V.	psig	0.00	0.01	0.17	0.18	0.18	0.18	0.35	
	Available Downstream Control Valve DP	psi								
	Pressure after Control Valve	psig	0.0000	0.0139	0.1719	0.1758	0.1758	0.1803	0.3475	
	Error Status		OK	OK	OK	OK	OK	OK	OK	
	Mach number at outlet	M	0.042	0.042	0.018	0.001	0.018	0.042	0.021	
		V[Mach]	265	265	265	265	265	265	133	

Attachment 2- Maximum Flow Hydraulic Calculations

	Hydraulic Calculations									
Client:	Marathon Oil	Basis / Notes -->								
Project: Location:			7	6	5	4	3	2	1	<= segment
Unit:	Max Flowrate									
Proj #:		Atm Pres 13.46	4" stm flare tip	4" After KO	6" Outlet of KO	KO	6" Before KO Drum	4" full flow to KO	4" Half of tanks	
By/Chk'd:	DJF	Pres Unit psia								
Rev/Date:	A 12-Sep-17	SEGMENT ID	G	H	I	J	K	L	M	
Pressure Data	Upstream Segment ID or known press.	psia								
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k	l	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	
Fric Method	(leftonog 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=isothermal)									
Holdup Meth	(blank=default, 2=Hughmark, 3=L-M, 4=B&B, 5=Eaton)									
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00021	
	Nominal Line Size or Internal Diameter	inches	4.000	4.000	6.000	24.000	6.000	4.000	4.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	
	Straight pipe length	ft	20.0	142.0	6.0	8.0	14.0	201.5	188.5	552 ft total
Elev-ation	Inlet & Outlet OR	Inlet ft								
		Outlet ft								
	Difference (Outlet - Inlet)	Difference ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's Std (R/D=1), threaded									
	Short Radius (R/D=1), flgd/welded									
	90's Standard (R/D=1.5), all types			3	1		1		2	
	Mitered 1 weld (90 deg angle)									
	2 weld (45 deg angle)									
	3 weld (30 deg angle)									
	Choose type: Plug Valve Branch Flow									
	Choose type: Plug Valve Straight Thru									
Elbows	45's Short Radius (R/D=1), all types									
	45's Standard (R/D=1.5), all types									
	Mitered, 1 weld, 45 deg angle									
	Mitered, 2 weld, 22.5 deg angle									
	Choose type: Ball Valve Full Port									
	180's Close Return (R/D=1), threaded									
	Close Return (R/D=1), flgd/welded									
	180 Standard (R/D=1.5), all types									
Tees	Used as an Elbow: Standard (R/D=1), threaded									
	Long-radius (R/D=1.5), threaded									
	Standard (R/D=1), flanged or welded							2	2	
	Stub-in type branch									
	Flow-thru Tee: Threaded									
	Flanged or Welded							1	18	
	Stub-in type branch									
Valves	Gate, Ball or Plug: Full line size, Beta=1.0				1		1		1	
	Reduced trim, Beta=0.9									
	Reduced trim, Beta=0.8									
	Globe, standard									
	Globe - (Angle or Y-type) or Diaphragm (dam type)									
	Butterfly									
	Check: Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5									
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5								1	
	Tilting-disk									
Other DP	Pipe Entrance/Exit? (0=none, 1=ent., 2=ext, 3=both)				1		2		1	
	Swage to Diameter (at end)	in			4.000			6.000		
	Orifice Diameter	in								
	Initial Swage from Diameter	in								
	Other Pressure Drop (Equip, etc.)	psi		0.113						1.81 osig dP through 4-inch Series 8
	Other Head Pressure Drop (Equip, etc.)	ft fluid								
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5								
	Miscellaneous Flow Resistance	K factor								
Liquid	Flow (provide mass OR volume basis)	lb/hr								
		gpm								
	Density	lb/ft3								
	Viscosity	cP								
	Surface Tension (2 phase only)	dyne/cm								
Vapor	Flow Rate	lb/hr	1,296	1,296	1,296	1,296	1,296	1,296	648	
	Density OR MW, Z & T: Density	lb/ft3								
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	4.026	6.065	23.250	6.065	4.026	4.026	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	1296	1296	1296	1296	1296	1296	648	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.02	0.21	0.39	0.39	0.40	0.59	0.83	
	Vapor Density (Avg)	lb/ft3	0.0640	0.0650	0.0658	0.0658	0.0659	0.0668	0.0679	
Flow Para-meters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.07	0.07	0.07	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884	
	Bulk Velocity	ft/sec	63.59	62.69	27.27	1.85	27.25	61.00	29.98	
	Erosional Velocity if solids present	ft/sec	395.15	392.36	389.79	389.73	389.66	387.03	383.69	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		1.99E+05	1.99E+05	1.32E+05	3.45E+04	1.32E+05	1.99E+05	9.95E+04	
	Friction Factor f (Colebrook & White)		0.0186	0.0186	0.0187	0.0230	0.0187	0.0186	0.0208	
Friction	K (straight pipe)		1.11	7.85	0.22	0.09	0.52	11.14	11.71	
	K (fittings + valves)		0.00	0.81	0.40	0.00	0.40	2.23	6.28	
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.01	0.31	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		1.11	8.67	1.66	0.09	1.93	13.68	18.60	
	Velocity Head (Average Density Basis)	ft fluid	62.84	61.08	11.55	0.05	11.54	57.83	13.96	
	Equivalent length	ft	20.0	156.7	44.8	8.0	52.2	247.3	299.4	
TOTAL	Upstream Pressure before CV	psig	0.0310	0.3842	0.39293	0.39294	0.40312	0.77117	0.89380	14.3 osig
	Available Upstream Control Valve DP	psi								
	Segment Upstream pressure	psig	0.03	0.38	0.39	0.39	0.40	0.77	0.89	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.11	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.03	0.24	0.01	0.00	0.01	0.37	0.12	
	Acceleration Factor		4.15E-03	4.03E-03	7.63E-04	3.53E-06	7.62E-04	3.82E-03	9.22E-04	
	Total System Pressure Drop	psi	0.03	0.35	0.01	0.00	0.01	0.37	0.12	
	Segment Downstream Pres., before C.V.	psig	0.00	0.03	0.38	0.39	0.39	0.40	0.77	
	Available Downstream Control Valve DP	psi								
	Pressure after Control Valve	psig	0.0000	0.0310	0.3842	0.3929	0.3929	0.4031	0.7712	
	Error Status		OK	OK	OK	OK	OK	OK	OK	
	Mach number at outlet	M	0.064	0.064	0.028	0.002	0.028	0.063	0.030	
		V(Mscfd)	405	405	405	405	405	405	203	

Stohler 41 CTB

STOHLER 41 CTB VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	Tim Archuleta	
CC:	Nate Mascarenas, Kendra Meeker	
DATE:	August 30, 2017	
RE:	Stohler 41 CTB - Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new Stohler 41 CTB vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2, will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the vent system 3D model (dated 8/16/2017) and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of 13.5 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.67 psig (10.8 oz/in^{2}g).

During normal operating conditions the 10.8 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 67% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in^2 was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 1.79 oz/in^2 and is based on the Enardo sizing program for a 6" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 971 Mscfd, and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary.

Using the same calculation methodology, the total gas flow rate can be increased to approximately 1140 Mscfd and stay at or below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in^2). This is approximately 1.17 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

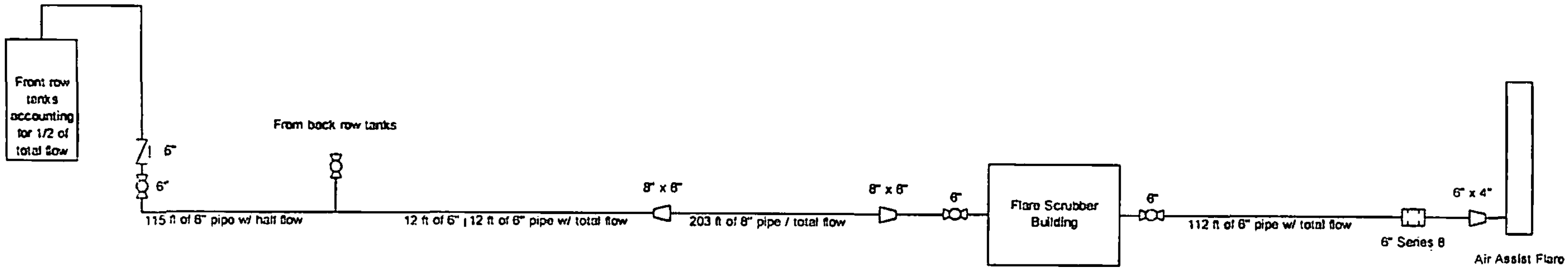
Attachment 1 - Normal Flow Hydraulic Calculations

			atm flare tip	Outlet of KO w/FA	6" valve at KO bldg	KO Drum	6" valve at KO bldg	Upstream of KO 8"	Upstream of KO 6"	Half of tanks valve	Half of tanks	
	Hydraulic Calculations											
Client:	Marathon Oil	Basis / Notes -->										
Project:	Stohler 41 CTB											
Location:												
Unit:	Normal Operating Scenario											
Proj #:	Atm Pres	13.5										
By/Chk'd:	DJF / Pres Unit	psia										
Rev/Date:	F1 18-Aug-17 SEGMENT ID		G	H	I	J	K	L	M	N	O	
Pressure Data	Upstream Segment ID or known press.	psia										
	Downstream Segment ID or known press	psia	13.50	G	H	I	J	K	L	M	N	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	d	
Fric Method	(blank=reg.2 or blank=Dukler, 3=L-M, 4=Begg Brill, 5=Isothermal)											
Holdup Meth	(blank=default,2 =Hughmark,3=L-M,4=B&B,5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Nominal Line Size or Internal Diameter	inches	4.000	8.000	6.000	24.000	6.000	8.000	6.000	6.000	6.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	std	
	Straight pipe length	ft	20.0	112.0		4.0		203.0	12.0		115.0	442 ft total
Elevation	Inlet & Outlet OR — Inlet	ft										
	Outlet	ft										
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's — Std (R/D=1), threaded											
	Short Radius (R/D=1), flgd/welded											
	90's — Standard (R/D=1.5), all types		1	3				1			2	
	Mitered — 1 weld (90 deg angle)											
	Mitered — 2 weld (45 deg angle)											
	Mitered — 3 weld (30 deg angle)											
Elbows	Choose type: Plug Valve Branch Flow											
	Choose type: Plug Valve Straight Thru											
	45's — Short Radius (R/D=1), all types											
	45's — Standard (R/D=1.5), all types							1				
	Mitered, 1 weld, 45 deg angle											
	Mitered, 2 weld, 22.5 deg angle											
	Choose type: Ball Valve Full Port											
	180's — Close Return (R/D=1), threaded											
	180's — Close Return (R/D=1), flgd/welded											
	180 — Standard (R/D=1.5), all types											
Tees	Used as an Elbow — Standard (R/D=1), threaded											
	Long-radius (R/D=1.5), threaded											
	Standard (R/D=1), flanged or welded							1			2	
	Stub-in type branch											
	Flow-thru Tee — Threaded											
	Flanged or Welded			1				1	1		3	
	Stub-in type branch											
Valves	Gate, Ball or Plug — Full line size, Beta=1.0				1		1			1		
	Reduced trim, Beta=0.9											
	Reduced trim, Beta=0.8											
	Globe, standard											
	Globe - (Angle or Y-type) or Diaphragm (dam type)											
	Butterfly											
	Check — Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5											
	Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5									1		
	Tilting-disk											
Other DP	Pipe Entrance/Exit? (0=none, 1=entr., 2=exit, 3=both)				1		2				1	
	Swage to Diameter (at end)	in		4.000				6.000	8.000			
	Orifice Diameter	in										
	Initial Swage from Diameter	in										
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.112								1.79 osig dP through 6-inch Series 8
	Other Head Pressure Drop (Equip, etc.)	ft fluid										
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5										
	Miscellaneous Flow Resistance	K factor										
Liquid	Flow (provide mass OR volume basis)	lb/hr										
		gpm										
	Density	lb/ft3										
	Viscosity	cP										
	Surface Tension (2 phase only)	dyne/cm										
Vapor	Flow Rate	lb/hr	3,107	3,107	3,107	3,107	3,107	3,107	3,107	1,262	1,262	
	Density OR MW, Z & T — Density	lb/ft3										
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	6.065	6.065	23.250	6.065	7.981	6.065	6.065	6.065	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	0	
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	3107	3107	3107	3107	3107	3107	3107	1262	1262	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.11	0.35	0.49	0.50	0.52	0.57	0.62	0.63	0.65	
	Vapor Density (Avg)	lb/ft3	0.0647	0.0658	0.0665	0.0665	0.0666	0.0669	0.0671	0.0672	0.0673	
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.2006	0.2006	2.9483	0.2006	0.3474	0.2006	0.2006	0.2006	
	Bulk Velocity	ft/sec	150.99	65.38	64.70	4.40	64.57	37.15	64.13	26.03	25.98	
	Erosional Velocity if solids present	ft/sec	393.25	389.83	387.81	387.65	387.41	386.70	386.08	385.87	385.55	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		4.77E+05	3.17E+05	3.17E+05	8.26E+04	3.17E+05	2.41E+05	3.17E+05	1.29E+05	1.29E+05	
	Friction Factor f (Colebrook & White)		0.0174	0.0169	0.0169	0.0191	0.0169	0.0169	0.0169	0.0187	0.0187	
Friction	K (straight pipe)		1.04	3.74	0.00	0.04	0.00	5.15	0.40	0.00	4.26	
	K (fittings + valves)		0.27	0.91	0.14	0.00	0.14	1.44	0.17	1.69	2.88	
	K (entrance + exit + swages + orifice)		0.00	0.43	0.61	0.00	1.01	0.21	0.18	0.00	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		1.30	5.08	0.75	0.04	1.16	6.80	0.75	1.69	7.75	
	Velocity Head (Average Density Basis)	ft fluid	354.30	66.43	65.06	0.30	64.80	21.45	63.91	10.53	10.49	
	Equivalent length	ft	25.2	152.1	22.5	4.0	34.7	288.3	22.5	45.5	209.1	
TOTAL	Upstream Pressure before CV	psig	0.2125	0.4793	0.50203	0.50204	0.53688	0.60476	0.62720	0.63550	0.67353	10.8 osig
	Available Upstream Control Valve DP	psi										
	Segment Upstream pressure	psig	0.21	0.48	0.50	0.50	0.54	0.60	0.63	0.64	0.67	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.21	0.15	0.02	0.00	0.03	0.07	0.02	0.01	0.04	
	Acceleration Factor		2.34E-02	4.39E-03	4.29E-03	1.99E-05	4.28E-03	1.42E-03	4.22E-03	6.95E-04	6.93E-04	
	Total System Pressure Drop	psi	0.21	0.27	0.02	0.00	0.03	0.07	0.02	0.01	0.04	
	Segment Downstream Pres., before C.V.	psig	0.00	0.21	0.48	0.50	0.50	0.54	0.60	0.63	0.64	
	Available Downstream Control Valve DP	psi										
	Pressure after Control Valve	psig	0.0000	0.2125	0.4793	0.5020	0.5020	0.5369	0.6048	0.6272	0.6355	
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	OK	
	Mach number at outlet	M	0.154	0.067	0.066	0.004	0.065	0.038	0.065	0.026	0.026	
	Homogeneous Friction Pres drop/100ft	psi/100ft	0.82	0.10	0.10	0.00	0.10	0.03	0.10	0.02	0.02	
		V [Ms cfd]	971	971	971	971	971	971	971	395	395	

Attachment 2 - Maximum Flow Hydraulic Calculations

	Hydraulic Calculations											
Client	Marathon Oil	Basis / Notes -->										
Project:	Stohler 41 CTB											
Location:												
Unit:	Max Flow Scenario											
Proj #:	Atm Pres	13.5	atm flare tip	Outlet of KO w/ FA	6" valve at KO bldg	KO Drum	6" valve at KO bldg	Upstream of KO 8"	Upstream of KO 6"	Half of tanks valve	Half of tanks	
By/Chk'd:	DJF / Pres Unit	psia										
Rev/Date:	IFI / 18-Aug-17	SEGMENT ID	G	H	I	J	K	L	M	N	O	
Pressure Data	Upstream Segment ID or known press.	psia										
	Downstream Segment ID or known press	psia	13.50	G	H	I	J	K	L	M	N	
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d	d	d	
Fric Method	(1=Haming, 2 or blank=Dukler, 3=L-M, 4=Begg-Brill, 5=Isothermal)											
Holdup Meth	(blank=default,2 =Hughmark,3=L-M,4=B&B,5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	
	Nominal Line Size or Internal Diameter	Inches	4.000	6.000	6.000	24.000	6.000	8.000	6.000	6.000	6.000	
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std	std	std	
	Straight pipe length	ft	20.0	112.0		4.0		203.0	12.0		115.0	442 ft total
Elevation	Inlet & Outlet — Inlet	ft										
	OR — Outlet	ft										
	Difference (Outlet - Inlet) — Difference	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3K Method	90's Std (R/D=1), threaded											
	90's Short Radius (R/D=1), flgd/welded											
	90's Standard (R/D=1.5), all types		1	3				1			2	
	Mitered 1 weld (90 deg angle)											
	Mitered 2 weld (45 deg angle)											
	Mitered 3 weld (30 deg angle)											
Elbows	Choose type Plug Valve Branch Flow											
	Choose type Plug Valve Straight Thru											
	45's Short Radius (R/D=1), all types											
	45's Standard (R/D=1.5), all types							1				
	Mitered, 1 weld, 45 deg angle											
	Mitered, 2 weld, 22.5 deg angle											
	Choose type Ball Valve Full Port											
	180's Close Return (R/D=1), threaded											
	180's Close Return (R/D=1), flgd/welded											
	180 Standard (R/D=1.5), all types											
Tees	Used as an Elbow Standard (R/D=1), threaded											
	Used as an Elbow Long-radius (R/D=1.5), threaded											
	Used as an Elbow Standard (R/D=1), flanged or welded							1			2	
	Used as an Elbow Stub-in type branch											
	Flow-thru Tee Threaded											
	Flow-thru Tee Flanged or Welded			1				1	1		3	
	Flow-thru Tee Stub-in type branch											
Valves	Gate, Ball or Plug Full line size, Beta=1.0				1		1			1		
	Gate, Ball or Plug Reduced trim, Beta=0.9											
	Gate, Ball or Plug Reduced trim, Beta=0.8											
	Globe, standard											
	Globe - (Angle or Y-type) or Diaphragm (dam type)											
	Butterfly											
	Check Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5											
	Check Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5									1		
	Check Tilting-disk											
Other DP	Pipe Entrance/Exit? (0=none,1=entr., 2=exit,3=both)				1		2				1	
	Swage to Diameter (at end)	in		4.000				8.000	8.000			
	Orifice Diameter	in										
	Initial Swage from Diameter	in										
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.151								2.42 osig dP through 6-inch Series 8
	Other Head Pressure Drop (Equip, etc.)	ft fluid										
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5										
	Miscellaneous Flow Resistance	K factor										
Liquid	Flow (provide mass OR volume basis)	lb/hr										
		gpm										
	Density	lb/ft3										
	Viscosity	cP										
	Surface Tension (2 phase only)	dyne/cm										
Vapor	Flow Rate	lb/hr	3,648	3,648	3,648	3,648	3,648	3,648	3,648	1,262	1,262	
	Density OR MW, Z & T — Density	lb/ft3										
	MW		29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	29.14	
	Z		0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	
	Temp	F	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Pipe Internal Diameter		in	4.026	6.065	6.065	23.250	6.065	7.981	6.065	6.065	6.065	
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0	0	0	
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Vapor	Flow Rate	lb/hr	3648	3648	3648	3648	3648	3648	3648	1262	1262	
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Segment Average Pressure	psig	0.15	0.47	0.67	0.68	0.71	0.78	0.84	0.86	0.88	
	Vapor Density (Avg)	lb/ft3	0.0649	0.0664	0.0673	0.0674	0.0675	0.0679	0.0681	0.0682	0.0683	
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
	Pipe Flow Area	ft2	0.0884	0.2006	0.2006	2.9483	0.2006	0.3474	0.2006	0.2006	0.2006	
	Bulk Velocity	ft/sec	176.75	76.06	75.01	5.10	74.80	42.99	74.13	25.62	25.58	
	Erosional Velocity if solids present	ft/sec	392.67	388.05	385.36	385.15	384.82	383.89	383.08	382.82	382.52	
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Reynolds Number (NRe)		5.80E+05	3.72E+05	3.72E+05	9.70E+04	3.72E+05	2.83E+05	3.72E+05	1.29E+05	1.29E+05	
	Friction Factor f (Colebrook & White)		0.0172	0.0166	0.0166	0.0185	0.0166	0.0166	0.0166	0.0187	0.0187	
Friction	K (straight pipe)		1.03	3.68	0.00	0.04	0.00	5.05	0.39	0.00	4.26	
	K (fittings + valves)		0.27	0.91	0.14	0.00	0.14	1.44	0.17	1.69	2.88	
	K (entrance + exit + swages + orifice)		0.00	0.43	0.61	0.00	1.01	0.21	0.18	0.00	0.61	
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Total K		1.30	5.02	0.75	0.04	1.16	6.71	0.74	1.69	7.75	
	Velocity Head (Average Density Basis)	ft fluid	485.49	89.91	87.44	0.40	86.96	28.72	85.39	10.20	10.17	
	Equivalent length	ft	25.2	152.6	22.8	4.0	35.2	269.4	22.6	45.5	209.1	
TOTAL	Upstream Pressure before CV	psig	0.2927	0.6536	0.68451	0.68452	0.73196	0.82290	0.85317	0.86133	0.89977	14.4 osig
	Available Upstream Control Valve DP	psi										
	Segment Upstream pressure	psig	0.29	0.65	0.68	0.68	0.73	0.82	0.85	0.86	0.90	
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Friction Pressure Drop	psi	0.28	0.21	0.03	0.00	0.05	0.09	0.03	0.01	0.04	
	Acceleration Factor		3.20E-02	5.93E-03	5.77E-03	2.67E-05	5.74E-03	1.90E-03	5.64E-03	6.73E-04	6.71E-04	
	Total System Pressure Drop	psi	0.29	0.36	0.03	0.00	0.05	0.09	0.03	0.01	0.04	
	Segment Downstream Pres., before C.V.	psig	0.00	0.29	0.65	0.68	0.68	0.73	0.82	0.85	0.86	
	Available Downstream Control Valve DP	psi										
	Pressure after Control Valve	psig	0.0000	0.2927	0.6536	0.6845	0.6845	0.7320	0.8229	0.8532	0.8613	
	Error Status		OK	OK	OK	OK	OK	OK	OK	OK	OK	
	Mach number at outlet	M	0.181	0.078	0.076	0.005	0.076	0.044	0.075	0.026	0.026	
	Homogeneous Friction Pres drop/100ft	psi/100ft	1.12	0.14	0.13	0.00	0.13	0.03	0.13	0.02	0.02	
		V (Mscfd)	1140	1140	1140	1140	1140	1140	1140	395	395	

Attachment 3 – Piping Layout



Front row tanks accounting for 1/2 of total flow
6"
6"
From back row tanks
115 ft of 6" pipe w/ half flow
12 ft of 6" | 12 ft of 6" pipe w/ total flow
8" x 6"
203 ft of 8" pipe / total flow
8" x 6"
6"
Flare Scrubber Building
6"
112 ft of 6" pipe w/ total flow
6" Series 8
6" x 4"
Air Assist Flare

TAT USA 34 Pad

HALKER
CONSULTING

7936 E. Arapahoe Ct., Suite 3200
Centennial, CO 80112
303-515-2700

TAT 34 FACILITY TANK BATTERY VENT LINE DESIGN AND CAPACITY ASSESSMENT

TO:	Marathon Oil	(b) (6) [redacted]
FROM:	John Van Pelt	
CC:	Tim Archuleta, Nate Mascarenas, Kendra Meeker	
DATE:	June 12, 2017	
RE:	TAT 34 Facility- Vent Line Design and Capacity Assessment	

The US EPA finalized "Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015" on June 3, 2016. This regulation has requirements for certifying the design of closed vent systems. An assessment of the closed vent must be performed to determine it is of sufficient design and capacity to ensure that all emissions from storage vessels are routed to the control device or process and have it certified by a qualified professional engineer. This regulation is 40 CFR 40 Subpart OOOOa, referred to as the Quad Oa regulation.

Certification for 40 CFR 60.5411a(d):

"I certify that the closed vent system design and capacity assessment was prepared under my direction or supervision. I further certify that the closed vent system design and capacity assessment was conducted and this report was prepared pursuant to the requirements of subpart Quad Oa of 40 CFR part 60. Based on my professional knowledge and experience, and inquiry of personnel involved in the assessment, the certification submitted herein is true, accurate, and complete. I am aware that there are penalties for knowingly submitting false information."

Purpose:

Evaluate the new TAT 34 facility tank battery vent line design to ensure that the Enardo ES-660 thief hatches, which are set at 16 oz/in^2 will not open during normal operating flow rate scenarios. The normal flow path for the vapor from the storage tanks will be to one flare where the off gas will be combusted to meet Quad Oa regulations.

Results:

Based on the 3D model of the vent system and predicted vapor flow rates, Halker Consulting evaluated the pipe routing from the storage tanks to the flare and calculated the expected pressure drop in the system during the Marathon Oil specified maximum predicted vapor flow rates. The pressure at the outlet of the flare was set at local atmospheric pressure of approximately 13.46 psia. Pressure drop through the piping system from the furthest storage tank to the flare was calculated and found to have a backpressure on the tank battery of 0.47 psig (7.5 oz/in^{2}g).

During normal operating conditions the 7.5 oz/in^{2}g pressure should be the highest pressure that the tanks will see and is 47% of the of 16 oz/in^{2}g set pressure of the thief hatch.

Calculations:

A flare tip pressure drop of 0.0 oz/in² was used and was based on information provided by Steffes Flare systems for the Air Assist Model 4. The flame arrestor pressure drop used was 1.1 oz/in² and is based on the Enardo sizing program for a 4" Series 8 inline flame arrestor.

The total gas flow rate to the flare used was 276 mscfd (883 lb/hr), and is based on a condensate flash factor and gas composition provided by Marathon Oil. The gas composition used was the average composition from the February 2017 Clarks Creek (MM) Analysis Summary. Credit was taken for the VRT thereby reducing the amount of flashed gas that was calculated using the provided flash gas factor.

Using the same calculation methodology, the total gas flow rate can be increased to 391 MSCFD (1251 lb/hr) and stay below the opening pressure of an Enardo ES-660 thief hatch (14.4 oz/in²). This is approximately 1.41 times the normal operating flow.

Standard pressure drop "K" value for fittings and valves per Crane Technical Paper 410 were used. The value used for the absolute roughness of steel was 0.00015 ft.

**Attached are the tabulated results of the hydraulic calculations*

Disclaimer:

This assessment meets the certification requirements of 40 CFR part 60 subpart 0000a. It is the responsibility of *Marathon Oil* to comply with the reporting requirements of this regulation.

This evaluation does not consider the destructive efficiency of the controlled device or components upstream of the tank vent design.

Attachment 1- Hydraulic Calculations

	Hydraulic Calculations											
Client:	Marathon Oil	Basis / Notes -->	7	6	5	4	3	2	1	<= segment		
Project:	TVCB Ventline											
Location:	TAT 34 Facility											
Unit:												
Proj #:	16039-02	Atm Pres 13.46	4" atm flare tip	4" After KO	6" Outlet of KO	KO	6" Before KO Drum	4" full flow to KO	4" Half of tanks			
By/Chk'd:	JVP	Pres Unit psia										
Rev/Date:	6-Jun-17	SEGMENT ID	G	H	I	J	K	L	M			
Pressure Data	Upstream Segment ID or known press.	psia										
	Downstream Segment ID or known press	psia	13.46	g	h	i	j	k	l			
	Is known pressure Up or Downstream (U or D)?		d	d	d	d	d	d	d			
Fric Method	(1=Homog, 2or blank=Dukler, 3=L-M, 4=Beggs Brill, 5=Isothermal)											
Holdup Meth	(blank/default 2=Hughmark, 3=L-M, 4=BBB, 5=Eaton)											
Pipe	Pipe Roughness	ft	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015			
	Nominal Line Size or Internal Diameter	inches	4.000	4.000	8.000	24.000	6.000	4.000	4.000			
	Schedule (40, std, etc.) Blank if I.D. given above		std	std	std	std	std	std	std			
	Straight pipe length	ft		128.1	7.8	8.0	7.8	190.3	198.6			
Elevation	Inlet & Outlet OR	Inlet ft										
		Outlet ft										
	Difference (Outlet - Inlet)	Difference ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
3K Method	90's Std (R/D=1), threaded											
	Short Radius (R/D=1), flgd/welded											
	90's Standard (R/D=1.5), all types			3	1		1		2			
	Mitered	1 weld (90 deg angle)										
		2 weld (45 deg angle)										
		3 weld (30 deg angle)										
	Choose type	Plug Valve Branch Flow										
	Choose type	Plug Valve Straight Thru										
Elbows	45's	Short Radius (R/D=1), all types										
	45's	Standard (R/D=1.5), all types										
		Mitered, 1 weld, 45 deg angle										
		Mitered, 2 weld, 22.5 deg angle										
	Choose type	Ball Valve Full Port										
		Close Return (R/D=1), threaded										
	180's	Close Return (R/D=1), flgd/welded										
	180	Standard (R/D=1.5), all types										
Tees	Used as an Elbow	Standard (R/D=1), threaded										
		Long-radius (R/D=1.5), threaded										
		Standard (R/D=1), flanged or welded		3				2	2			
		Stub-in type branch										
	Flow-thru Tee	Threaded										
		Flanged or Welded		1				3	11			
		Stub-in type branch										
Valves	Gate, Ball or Plug	Full line size, Beta=1.0			1			1	1			
		Reduced trim, Beta=0.9										
		Reduced trim, Beta=0.8										
	Globe, standard											
	Globe - (Angle or Y-type) or Diaphragm (dam type)											
	Butterfly											
	Check	Lift - min vel (ft/s)= 35/(dens lb/ft3)^.5										
		Swing - min vel (ft/s)= 40/(dens lb/ft3)^.5							1			
		Tilting-disk										
Other DP	Pipe Entrance/Exit?(0=none,1=entr., 2=exit,3=both)				1		2		1			
	Swage to Diameter (at end)	in			4.000			6.000				
	Orifice Diameter	in										
	Initial Swage from Diameter	in										
	Other Pressure Drop (Equip, etc.)	psi	0.000	0.068								
	Other Head Pressure Drop (Equip, etc.)	ft fluid										
	Valve Cv (Non-flashing liquid only)	gpm/psi^.5										
	Miscellaneous Flow Resistance	K factor										
Liquid	Flow (provide mass OR volume basis)	lb/hr										
		gpm										
	Density	lb/ft3										
	Viscosity	cP										
	Surface Tension (2 phase only)	dyne/cm										
Vapor	Flow Rate	lb/hr	883.42	883.42	883.42	883.42	883.42	883.42	441.71			
	Density OR MW, Z & T	Density lb/ft3										
		MW	29.14	29.14	29.14	29.14	29.14	29.14	29.14			
		Z	0.994	0.994	0.994	0.994	0.994	0.994	0.994			
		Temp F	115.0	115.0	115.0	115.0	115.0	115.0	115.0			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
Pipe Internal Diameter		in	4.026	4.026	8.065	23.250	6.065	4.026	4.026			
DP / Holdup Calculation Methods			Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh	Duk/Hugh			
Liquid	Flow rate	lb/hr	0	0	0	0	0	0	0			
	Flow rate	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Density	lb/ft3	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Viscosity	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Surface Tension (2 phase only)	dyne/cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Vapor	Flow Rate	lb/hr	883	883	883	883	883	883	442			
	Vapor Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Segment Average Pressure	psig	0.00	0.11	0.22	0.22	0.22	0.32	0.44			
	Vapor Density (Avg)	lb/ft3	0.0640	0.0645	0.0650	0.0650	0.0650	0.0655	0.0661			
Flow Parameters	Bulk Density (Avg)	lb/ft3	0.06	0.06	0.07	0.07	0.07	0.07	0.07			
	Pipe Flow Area	ft2	0.0884	0.0884	0.2006	2.9483	0.2006	0.0884	0.0884			
	Bulk Velocity	ft/sec	43.39	43.05	18.82	1.28	18.81	42.39	21.01			
	Erosional Velocity if solids present	ft/sec	395.38	393.80	392.21	392.18	392.15	390.60	389.06			
	Average Viscosity	cP	0.010	0.010	0.010	0.010	0.010	0.010	0.010			
	Elevation Change (Outlet-Inlet)	ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
	Reynolds Number (NRe)		1.36E+05	1.36E+05	9.00E+04	2.35E+04	9.00E+04	1.36E+05	6.78E+04			
	Friction Factor f (Colebrook & White)		0.0193	0.0193	0.0198	0.0251	0.0198	0.0193	0.0213			
Friction	K (straight pipe)		0.00	7.38	0.30	0.10	0.30	11.49	12.60			
	K (fittings + valves)		0.00	4.07	0.40	0.00	0.25	2.75	6.49			
	K (entrance + exit + swages + orifice)		0.00	0.00	1.04	0.00	1.02	0.31	0.61			
	K (Miscellaneous Flow Resistance + Valve Cv)		0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Total K		0.00	11.46	1.74	0.10	1.57	14.55	19.71			
	Velocity Head (Average Density Basis)	ft fluid	29.29	28.80	5.50	0.03	5.50	27.93	6.86			
	Equivalent length	ft	0.0	198.8	44.5	8.0	40.2	252.4	310.5			
TOTAL	Upstream Pressure before CV	psig	0.0000	0.2162	0.2205	0.2205	0.22442	0.40954	0.472	<=	7.5	oz.in2
	Available Upstream Control Valve DP	psi										
	Segment Upstream pressure	psig	0.00	0.22	0.22	0.22	0.22	0.41	0.47			
	Static Head Pressure Drop	psi	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	Other Pressure Drop (Equip & Allow)	psi	0.00	0.07	0.00	0.00	0.00	0.00	0.00			
	Friction Pressure Drop	psi	0.00	0.15	0.00	0.00	0.00	0.18	0.06			
	Acceleration Factor		1.93E-03	1.90E-03	3.63E-04	1.88E-06	3.63E-04	1.84E-03	4.53E-04			
	Total System Pressure Drop	psi	0.00	0.22	0.00	0.00	0.00	0.19	0.06			
	Segment Downstream Pres., before C.V.	psig	0.00	0.00	0.22	0.22	0.22	0.22	0.41			
	Available Downstream Control Valve DP	psi										
	Pressure after Control Valve	psig	0.0000	0.0000	0.2162	0.2205	0.2205	0.2244	0.4095			
	Error Status		OK	OK	OK	OK	OK	OK	OK			